# Part I

# Technology Development Promotion

# Chapter 1. Cluster

Deukgyu Bok[1]

Clustering refers to a geographic concentration of companies, colleges and research labs. Combined, they can achieve synergy effects in terms of sharing in the results of technology development, human resources, and information. A cluster also includes financial institutions and other service providers to support various business services.

As such, "cluster" has emerged as a new key success factor of an economy in this era of a knowledge-based economy. Especially for Korea, which is facing the growing challenges from China as the world's factory, it is urgent for the nation to upgrade its industrial structure and enhance companies' competitiveness by forming clusters. However, at this time, Korea seems only at the initial stage in order to develop clusters. In the past, the nation only established policies for the development of industrial complexes, which are simply an aggregate of companies or factories and only for the construction or the development of infra-structure and land for factories. Nevertheless, there are encouraging signs that the Korean government is now considering policy options to develop clusters comprehensively.

Developed with input from experiences of cluster formation in all over the world including Korea, the course will provide a real-world view into the best practices of cluster formation and cluster management. Participants will develop skills and gather tools to enhance the success of their cluster policy-making and management.

## 1. Concept

### 1.1. Definition

A cluster is a geographically proximate group of interconnected companies and associated institutions (e.g. universities, standards agencies, and trade associations) in a particular field, linked by commonalities and complementarities (Porter, 1998). Clusters have drawn increased interest from many regions around the world as knowledge-based economies grew increasingly dominant in the 1990's.

Interest in clusters stems from the fact that innovation and knowledge creation still benefits greatly from face to face communication among participants. This stands in marked contrast to the predictions of many earlier technology watchers that "physical location" would decline in importance as telecommunications grew ever more affordable and sophisticated. In this sense, the increasing

[1] Senior Researcher, Technology & Industry Department, SERI, Korea

popularity of clusters appears to stem from their possession of the right factor for knowledge creation and technology innovation. Clusters promote innovation and learning through co-operations and improved flows of information and knowledge; they act as magnets for the most competent firms and the best trained labor force; they provide a favorable environments for the launching of new firms; and they spur economic growth and upgrade competitiveness, creating jobs (Nauwelaers, 2003).

Clusters are characterized by five defining features; including: (1) geographical concentration, (2) the presence of the appropriate firms and institutions, (3) specialization in particular fields, (4) well developed networks connecting firms and institutions, and (5) promotion of innovation.

### 1.1.1. Geographical Concentration

All clusters begin with a geographical concentration of firms and institutions (including governmental bodies). As telecommunications technology has improved and costs have decreased, many companies can now manage their business on a global scale regardless of distance. Under these circumstances, one might legitimately wonder why firms and institutions still prefer to locate in a specific region. Porter noticed this issue when he stated, “If the importance of location has been decreased, why do world-class investment firms continue to gather in the Boston area, automobile manufacturing companies in Southern Germany, and fashion companies in Northern Italy?” Porter concluded that firms which belong to a cluster have advantages in knowledge, relationships, and incentives that do not accrue to firms working outside a cluster.

What then would be the physical boundaries of a cluster? From the foregoing definition, it could be inferred that clusters are bound by the connections and complementary relations between industries and institutions that characterize them. Although some clusters fit into political boundaries, many clusters can cross political boundaries and even national borders. Clusters come in a range of sizes. Silicon Valley, for example, covers several counties and an area of some 1,500 square-miles, while Kista Science City in Sweden has an area of only 200 thousands square-meters. Japan has a semi-official cluster policy stating the distance should be approximately 1~2 hours by car. In short, boundaries of clusters are determined according to the size and customs of each country or region. The most salient fact with respect of a cluster is that participants are close enough together to meet frequently and communicate in a face-to-face manner.

### 1.1.2. Presences of Diverse Firms and Institutions

Cluster encompasses an array of linked industries and other entities not commonly thought of as parts of an industry. Such organizations can include specialized input providers, service

providers, education and training centers and providers of specialized infrastructure (Porter, 1998). Clusters can further expand to customers, sales channels, and providers of complementary products and services. Finally, many clusters may include educational and governmental agencies, (e.g. universities, think tanks, technical support agencies and staffing agencies).

The “wine cluster” in Northern California is an illustrative example. Northern California’s wine cluster includes not only the wine industry but many other entities that are not commonly considered as parts of the industry; including local governments, colleges, and research institutes. The wine cluster also maintains an extensive complements of supporting entities for both wine making and grape agriculture; including providers of grape stock, irrigation and harvesting equipments, barrels and labels; specialized public relation and advertising firms, and numerous wine publications (Porter, 1998). The California wine cluster also maintains relations with the food and the tourism clusters in California.

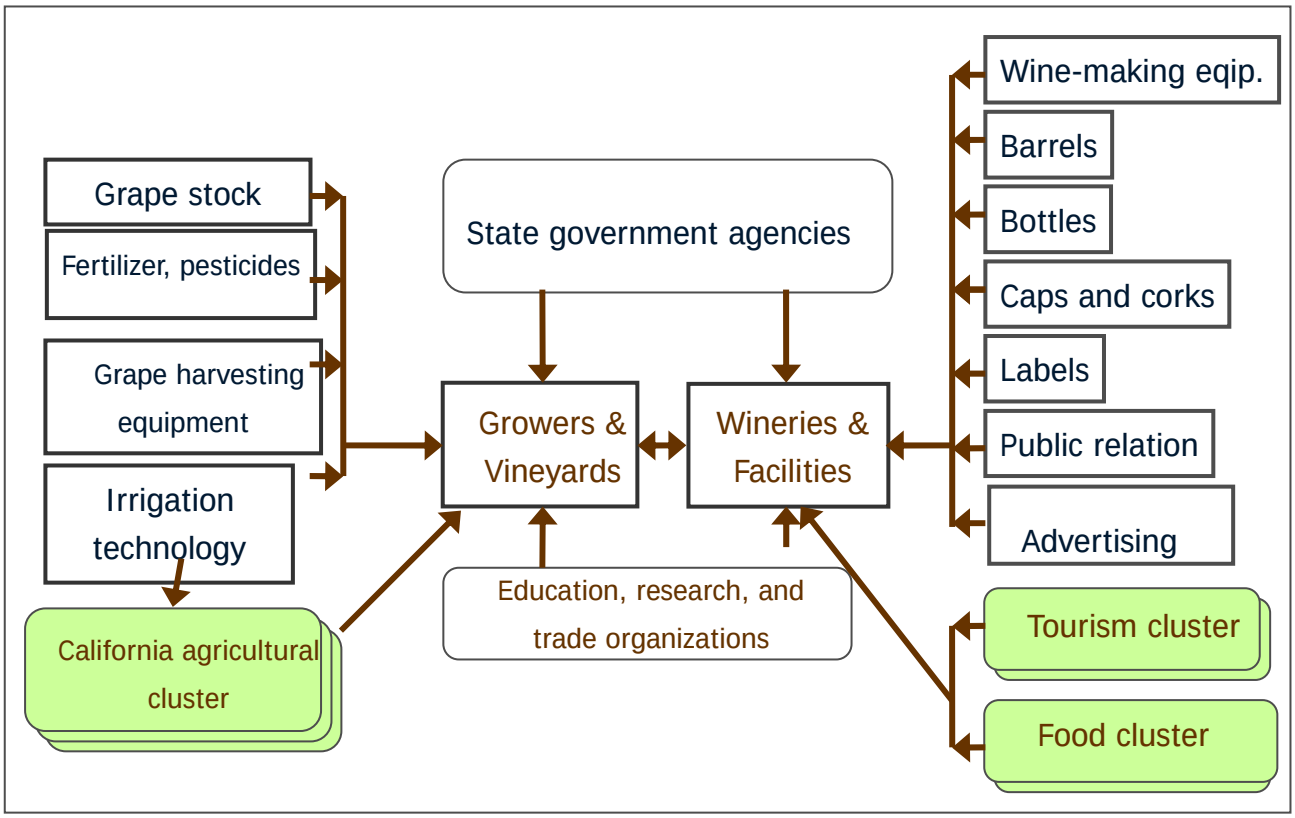



**Fig 1 Diverse Entities in a California Wine Cluster**

Source: Porter (1998)

### 1.1.3. Specialization in Particular Fields

The foregoing definition of a “cluster” also requires specialization of the region in a particular field.[2] If the companies and institutes in a cluster do not focus on a particular field, synergy or agglomeration effects would not arise. Specialization need not be limited to one industry or skill and several industries and/or skills can overlap. For example, Silicon Valley maintains more than firms and institutions that provide information technology; it also maintains many “biotech” and “nanotech” firms. These firms pool their world class R&D functions and drive the culture of entrepreneurship in the Silicon Valley region.

A cluster’s specialization is closely related to its origin as a cluster. Silicon Valley, for example, developed from Stanford University, one of the world’s strongest research centers for information technology, while the San Diego biotech cluster emerged from University of California at San Diego’s strong research capability in that industry. Logistics clusters in the Netherlands were formed by leveraging the geographical advantages of that country, including its central European location, broad water channels, and efficient port at Rotterdam. Further examples include Kista Science Park in Sweden, which developed around Ericson, Sweden’s largest corporation in telecommunication service and equipment provider, and Toyota City in Japan, which revolves around Toyota, the world’s largest automobile company.

### 1.1.4. Networks among Firms and Institutions

Porter (1998) used the word ‘group’ as part of his definition of “cluster” to emphasize the existence of networks among the firms and institutions contained within a cluster. While this definition of “network” encompasses physical trade between agents, networks also (and more saliently) act as conduits for the circulation of information and knowledge. Each member in a cluster can access the networks via their personal relations and community ties. Various conferences and seminars held within a cluster and casual meetings at bookstores, coffee shops, and bars further augment networks as effective conduits for the circulation of information and knowledge.

As regards organization theory, a cluster is a hybrid, fluid “organization” encompassing aspects of market and vertically integrated organization (i.e. firms). Compared with trade on the market, clusters have the advantage of boosting cooperation among firms and institutions via their common identity, while providing various networks that strengthen the exchange of information and knowledge. Compared with the vertical integration, clusters enjoy superior ability to promote flexibility and competition, as the weak linkages between firms and institutions in a cluster promote market competition. In brief, a cluster can actually be a robust organizational structure that prevents the disadvantages arising from both the rigid vertical

[2] In this case, field refers to an industry (IT, automobile, software etc.) or a function (R&D, production, parts etc).

integration within a firm and the rack of structure inherent to a market.

### 1.1.5. Promotion of Innovation

Clusters tend to promote innovation through smooth circulation of information and knowledge because, other things being equal, a company outside a cluster will spend more time and expense in creating its own proprietary information and knowledge. Furthermore, companies in a cluster may benefit from the more flexible business models provided through the use of supporting firms and institutions in the cluster.

Another factor supporting innovation is the pressure of competition within a cluster. Since companies in a cluster are located relatively close together, pressure from competitors is greater within a cluster than outside the cluster. To avoid falling behind competitors, firms in a cluster must look for new business opportunities and ceaselessly renew and redevelop their technologies. Companies within a cluster will also enjoy easier conditions when starting a business, as clusters provide superior information about new business opportunities and other necessary services like financing, human resources, and technologies. Lowered barriers to entry within a cluster also intensify the competition therein.

### 1.1.6. Notes on the Diversity of Clusters

It is worth pointing out that the clusters come in a variety of forms. Clusters are diverse in many aspects. First, the formation of a cluster need not limited to high-technical industries. Agriculture and entertainment industries, for example, have long formed clusters.[3] Second, geographical boundaries for clusters may differ in scale, from small towns to counties, to “global scale” clusters. For example, the shoemaking and leather cluster in Italy had its origins in a small town, whereas, Silicon Valley spans several counties in California, while simultaneously being linked with around the world. Third, clusters differ functionally from each other. Some clusters concentrate on R&D while other clusters focus on production or the manufacture of specific parts. Finally, the firms and other institutions that constitute a cluster can also vary. In Italy, clusters tend to form among small and medium-sized firms, while in small but open economies like Sweden and Finland, clusters tend to coalesce around large companies, like Ericson and Nokia. A cluster may focus on colleges and research institutions like the bio-technology cluster in San Diego, California or it may include other entities like start up firms, universities, research institutions and multinationals.

[3] For example, the aforementioned wine cluster in California is an agricultural cluster, while Hollywood is a universally known film cluster.

## 1.2. Other Regional Innovation Models

Over the decades, many scholars and planners have tried to seek out ‘new’ models of regional development. This paper will briefly introduce three regional innovation models related to clusters: industrial districts, new industrial spaces, and regional innovation systems (RIS).[4]

### 1.2.1. Industrial Districts

The idea of “industrial districts” originated with Marshall, in his book ‘Industry and Trade’ published in 1919. In this book, the industrial districts are explained as a “geographically localized productive system”, based on a strong local division of labor between small forms specialized in different functions of the process of production. This production system involves multiple relationships between firms, as well as between firms and the local community. Such relationships are commonly based on trust and reciprocity and cannot be understood without considering the role of historical and socio-economic factors. Industrial districts generate benefits like pooling of labor, low transportation costs, and easy access to raw material and parts. This benefit, often called, “agglomeration effects” results from firms being situated in a particular location.

Industrial districts theory attracted relatively little attention until the mid 1980’s, when the success of Italian firms brought renewed attention to the idea (Piore and Sabel, 1984). Italian firms, especially those located in the north pf the country, attained massive success in fashion industry by responding very swiftly to the fast changing demands of world fashion industry through a production system that mimicked Marshall’s idea of industrial districts. These small Italian firms deployed a division labor over a particular area; using a system based on networks of trust and reciprocity built over long period of time. After the success of the Italian firms, many scholars and planners began to re-assess the competitiveness and the value of industrial districts.

### 1.2.2. New Industrial Spaces

Industrial districts theory emphasizes the agglomeration of small firms with small firms as the primary agents within industrial districts. This reflects the early stage of industrial development during which Marshall lived. However, in modern industrial times, firms can differ vastly in their size, while relationships between such firms can be diverse, ranging from subcontracting and strategic alliances to co-production and co-marketing. Large firms may act

[4] There are other regional innovation models; including “innovative milieu,” “learning region,” and “local production systems” (Moulaert and Sekia, 2003).

as an incubator for new firms, including startups. From the perspective of participants in modern industry, industrial districts function as a special kind of agglomerations.

Storper and Scott launched this notion of ‘new industrial spaces’ in a paper published in 1998 called “The geographical foundation and social regulation of flexible production complexes” in line with a survey on regional innovation models (Moulaert and Sekia, 2003). This theory of new industrial spaces combines industrial districts, social regulation, and local community dynamics. “New industrial spaces” as a theory involves not only agglomeration effects but also “social regulation systems” which provide (i) the coordination of inter-firm transactions and the dynamics of entrepreneur activity, (ii) the organization of local labor markets and social reproduction of workers, and (iii) the dynamics of community formation and social reproduction. Storper and Scott linked the efficiency of the flexible production system to the agglomeration of a selected set of producers (Moulaert and Sekia, 2003): “This strategy enables them to reduce the spatially-dependent cost of external transactions. In flexible production systems, the tendency to agglomeration is reinforced not only by externalization but also by intensified re-transacting, just-in-time processing, idiosyncratic and variable forms of inter-unit transaction, and the proliferation of many small-scale linkages with high unit costs.”

### 1.2.3. Regional Innovation Systems

Regional Innovation Systems (RIS) are networks of firms and institutions that facilitate the development of products or processes in the innovation and commercialization of knowledge. RIS consists of an upper structure and lower structure where lower structure refers to physical infrastructure like roads, ports, telecommunication networks and institutional infra (i.e. universities, research institutes, financial institutes, and training centers, etc). Upper structure denotes organizational systems, cultures, and norms of the local community.

RIS theory emphasized the role of region in the process of actual innovation. Although central governments may plan the policy, regions actually implement the policy, making systems formulated in the region of greater importance in the ultimate execution.

The next table summarizes the theories of regional innovation models.

**Table 1 Other Regional Innovation Models**

| Features of innovation | Industrial districts | New industrial spaces | Regional innovation systems |
|---|---|---|---|
| Core of innovation dynamics | Capacity of actors to implement innovation in a system of common values | A result of R&D and its implementation; application of new production methods(JIT, etc.) | Innovation as an interactive, cumulative and specific process of R&D (path dependency) |
| Role of institutions | Institutions are 'agents' and enabling social regulation, fostering innovation and development | Social regulation for the coordination of inter-firm transactions and the dynamics of entrepreneurial activity | As in the National Systems of Innovation, the definitions vary according to authors, but they all agree that the institutions lead to a regulation of behavior, both inside and outside organization |
| Regional development | Territorial view based on special solidarity and flexibility of districts; this flexibility is an element of this innovation | Interaction between social regulation and agglomerated production systems | View of the region as a system of 'learning by interacting/and by steering regulation' |
| Culture | Sharing values among industrial districts agents; trust and reciprocity | Culture of networking and social interaction | The source of learning by interacting |
| Types of relation among agents | The network is a social regulation mode and a source of discipline. It enables a coexistence of both cooperation and competition | Inter-firm transactions | The network is an organizational mode of 'interactive learning' |
| Type of relations with the environment | The relationships with the environment impose some constraints and new ideas; must be able to react to changes in the environment; 'rich' relations; limited spatial view of environment | The dynamics of community formation and social reproduction | Balance between inside specific relations and environment constraints; 'rich' relations |

Source: Moulaert and Sekia, 2003

## 2. Advanced Clusters

### 2.1. Classification of Clusters

We have selected four successful advanced clusters, Silicon Valley in U.S.A., Sophia-Antipolis in France, Toyota City in Japan and Hsinchu Science-based Industrial Park in

Taiwan. The clusters were selected based on their main function (“innovation-based” or “industry-focused”) and their original facilitator (“market” or “policy”). These four types of clusters have developed very different regional resources profiles by accumulating resources in a different manner, cultivating different capabilities, and providing different sources of regional advantage.[5] This paper will explain the current profile, the history, and the factors for success in each cluster.

**Table 2 A Classification of Advanced Clusters**

| | |
|---|---|
| “Innovative & Market-led” Clusters: Silicon Valley | “Innovative & Policy-led” Clusters: Sophia-Antipolis |
| “Industrial & Market-led” Clusters: Toyota City | “Industrial & Policy-led” Clusters: Hsinchu Science–based Industrial Park |

## 2.2. Silicon Valley

### 2.2.1. Profile and Brief History

Silicon Valley covers several counties in California that encompasses an area of 1,500 square-miles and 2006 population of 2,440,000 (Joint Venture: Silicon Valley Network, 2007). The region had attained its nickname, Silicon Valley, as early as 1970, as it grew into a center for the burgeoning semiconductor and computer industry. Since then, Silicon Valley has gone through a number of ups and downs, experienced its most recent difficulties after the collapse of the IT bubbles in the early 2000’s. Nevertheless, investments and the overall population have started to increase again from 2004. Recently, Silicon Valley’s industrial structure has started to shift form a concentration on IT towards nanotechnology, energy & environments and bio-technology industries.

In fact, the shift from agriculture to high tech in Silicon Valley started as early as the 1930’s. At that time, Dr. Terman of Stanford University encouraged graduated students to start businesses in what would become Silicon Valley on concern that talented students would be tempted to move to lucrative jobs offered by companies in East. One venture which started with the advice from professor Terman would later become Hewlett-Packard, today the world’s largest information technology company.

Over the next few decades, Silicon Valley would pass through four stages of growth, from an early focus on defense contracting, to the Internet, and on to its next phase of development. The ability to easily leap from one technology to another technology has been the backbone

[5] See John and Pouder (2006) for the difference between “innovation-based” clusters and “industry-focused” clusters.

of Silicon Valley's remarkable dynamism and continuous success.

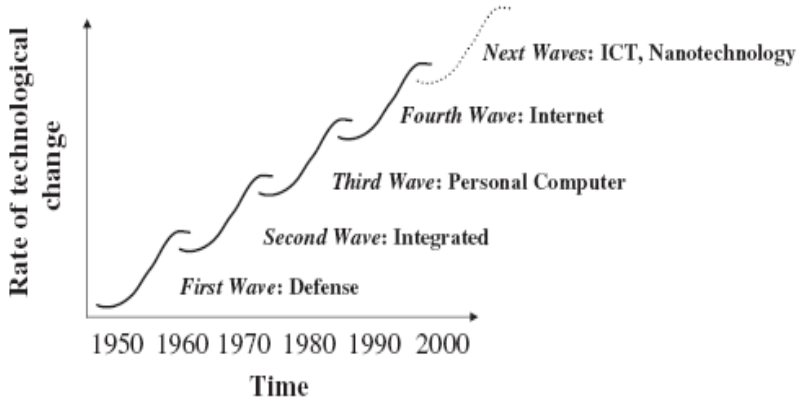



**Fig 2 The Evolution of Silicon Valley**

Source: Lee et al., 2000

### 2.2.2. Factors for Success

One of the main factors that lead to Silicon Valley's success is its spirit of entrepreneurialism and its pursuit of the "American Dream." Entrepreneurs in Silicon Valley can amass huge wealth nearly overnight when launching new technology successfully. Another important factor that has helped to foster entrepreneurship is its culture of tolerating failure. In Silicon Valley 'learning by failing' is a very common catchphrase, and honest failure is not punished.

The second factor for success is the availability of a very highly talented workforce, as Silicon Valley boasts several world class universities including Stanford and Berkeley that provide an army of highly trained specialists. Furthermore, since companies in Silicon Valley consider a person's ability as the most important factor, talented people in the world can gather in Silicon Valley regardless of race, age, or gender. As a result, scientists and engineers from foreign countries accounted for 55% of the total number of scientist and engineers working in the Valley in 2005 (Joint Venture: Silicon Valley Network, 2007).

Financing systems to fund new technologies have been another factor for success. In third quarter of 2006, venture capital funds invested in Silicon Valley amounted to 5.2 billion dollars. Venture capital invested in Silicon Valley accounts for 27% of total venture capital investments in America.

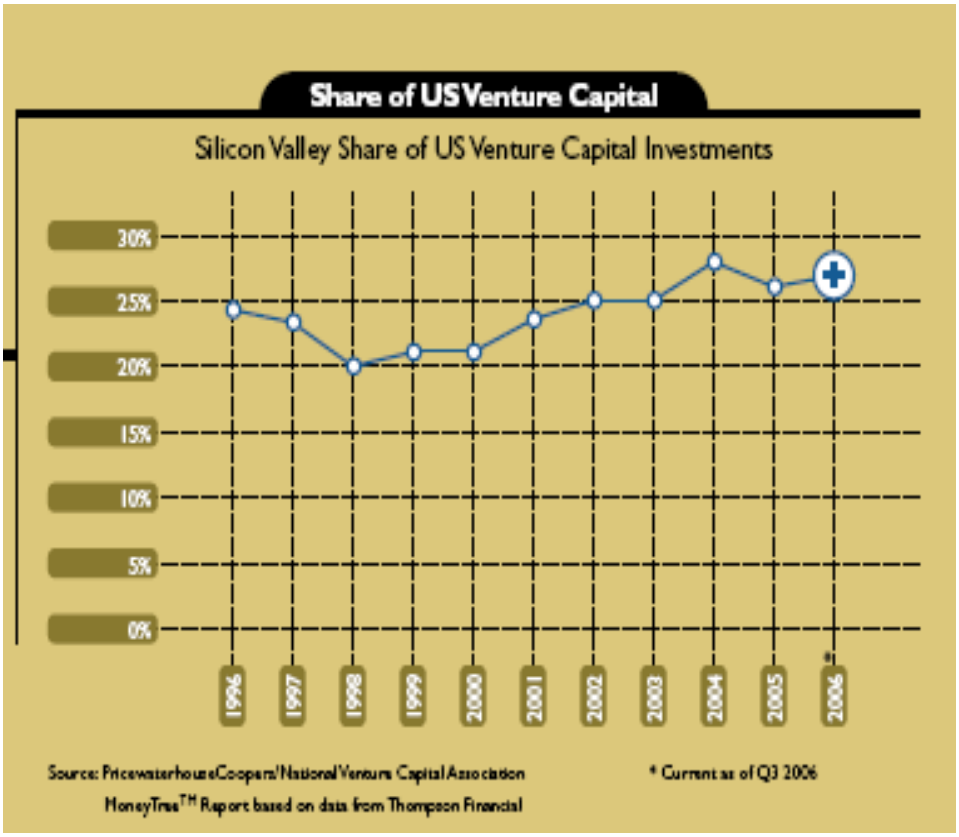



**Fig 3 Silicon Valey Share of US Venture Capital Investment**

Source: Joint Venture: Silicon Valley Network, 2007

Venture capitalists in Silicon Valley differ from ordinary venture capitalist in important ways. Venture capital in Silicon Valley who are usually familiar with technology not only supplies funds but also offers management expertise to startups (Lee et. al, 2001), and provide a complementary management role to their prospective investments.

The presence of related companies is also another factor for success in Silicon Valley. Firms in Silicon Valley are able to deploy networks among companies and institutions which support fast commercialization, among them universities and research institutes that can deliver advanced technology to industry (in particular, Stanford University, the world's leader in engineering, physics, and biotechnologies). Well-developed service firms that provide specialized services such as professional testing, marketing, packaging, exhibitions, accounting, legislation and head-hunting, have also been important factors for success of firms in Silicon Valley.

According to the 'Index Silicon Valley 2007', networks in Silicon Valley are not limited to the area of Silicon Valley itself, and are in fact connected to the entire world. As a result, the patents with companies in Silicon Valley and ones outside in Silicon Valley increased six times in 2005 over their 1993 number.

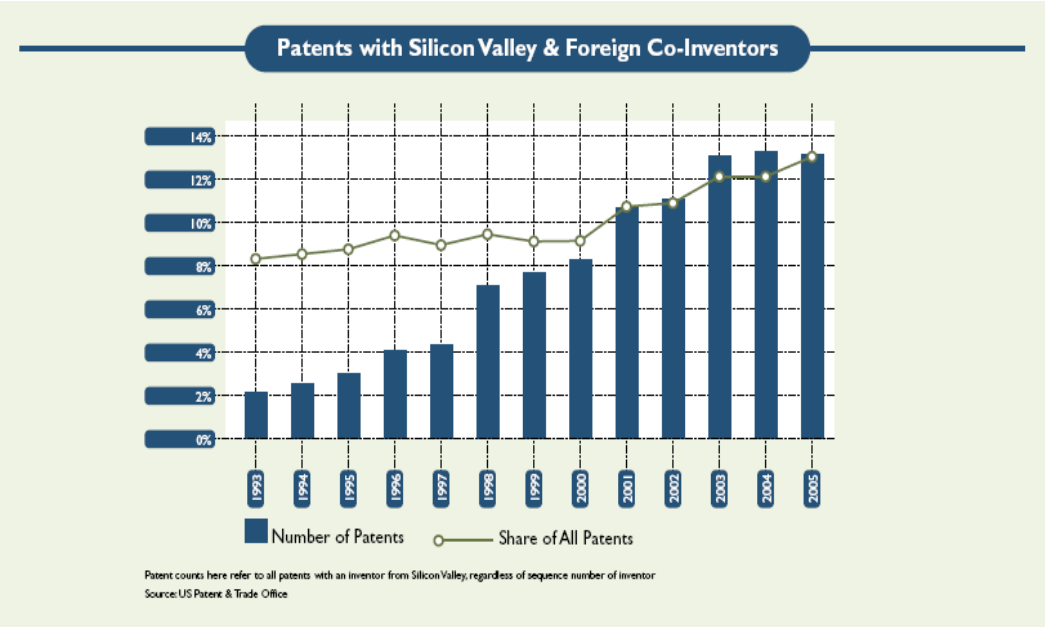



**Fig 4 Patents with Silicon Valley & Foreign Co-Inventors**

Source: Joint Venture: Silicon Valley Network, 2007

## 2.3. Sophia-Antipolis

### 2.3.1. Profile and Brief History

Sophia-Antipolis is located between Cannes and Nice on the French Riviera, an area well-known as a playground for celebrities and other luminaries. The Riviera offers world class recreation and leasure facilities and unparalleled scenery. Researchers, engineers and managers in companies who wish to be free from the stultifying monotony of urban office culture are greatly drawn to the attractions of the Sophia-Antipolis area.

The main industries in Sophia-Antipolis are IT (information and telecommunication) and services. Companies in IT sector account for 50% of all jobs and 29% of all office space in the area while services account for 50% of all companies, 26% of all jobs, and 32% of all office space. Biotechnology has been a recent strong performer, accounting for 4% of all firms, 8% of all jobs, and 12% of all office space.

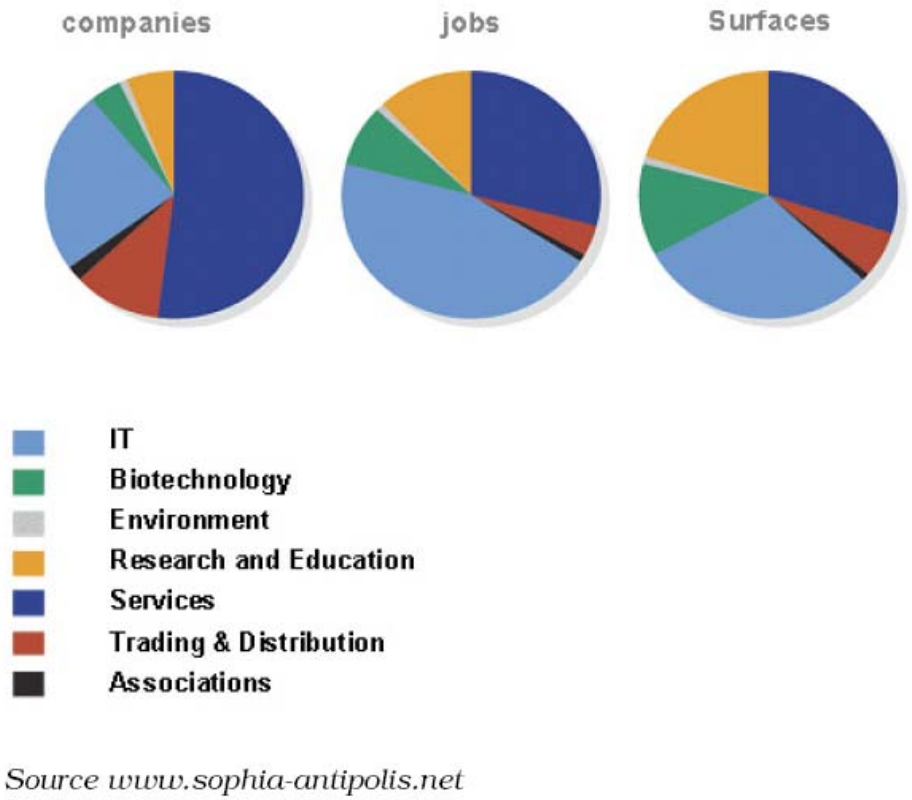



**Fig 5 The Distribution of Industry in Sophia-Antipolis**

Sophia-Antipolis could not exist without the influence of one man, Pierre Laffitte, then Assistant Director of the renowned engineering school, L'Ecole Nationale des Mines de Paris. He suggested a rather lofty 'City of Science and Wisdom' and proceeded to embody the idea more concretely in a specific project (Longhi, 1999), whereupon his idea was accepted by the council of the Cote d'Azur area. The council also established its Sophia-Antipolis Joint Management Board, or SYMISA, composed of representatives of local governments and business associations. SYMISA would later established SAEM, which managed the region's facilities and marketing.

However, up to the late 1980's, the area had experienced insufficient networking for the development of cluster (Longhi, 1999). Construction of networks did not begin in earnest until the early 1990's, and with the recession in the early 1990's, large companies operating in Sophia-Antipolis actually increased divestments and outsourcings. Paradoxically, this proved to be the stimulus from which small and medium-sized companies form networks.

### 2.3.2. Factors for Success

One factor that led to success for Sophia-Antipolis is its high quality of life, with pleasant weather and an enjoyable working environment. The environment had long proved to be an

attraction, as well before the establishment of SYMISA, IBM and Texas Instrument had already established themselves in Nice in the 1960's. The attractive environment would continue to draw firms in research and development and leading-edge technology. To maintain the environment, Sophia-Antipolis preserved green belts and parks at 2/3 of the total area, and enforced height limitations to maintain its spectacular scenic views.

The French government's policy for balanced regional development also played an important role. Under this policy, Sophia-Antipolis could depend on the presence of government-funded research institutions and R&D programs.

Furthermore, although it took significant time for them to be fully realized, community activities between companies and professional groups in Sophia-Antipolis also played an important role in the region's success. Since the 1990's, various "clubs" have been established to communicate information and new ideas and to start new projects. One of the most representative examples is "Telecom Valley Club" built on 1991. The club includes local government and associations, and encompassed more than 70 companies, including major players like IBM, AT&T, and Texas Instruments.

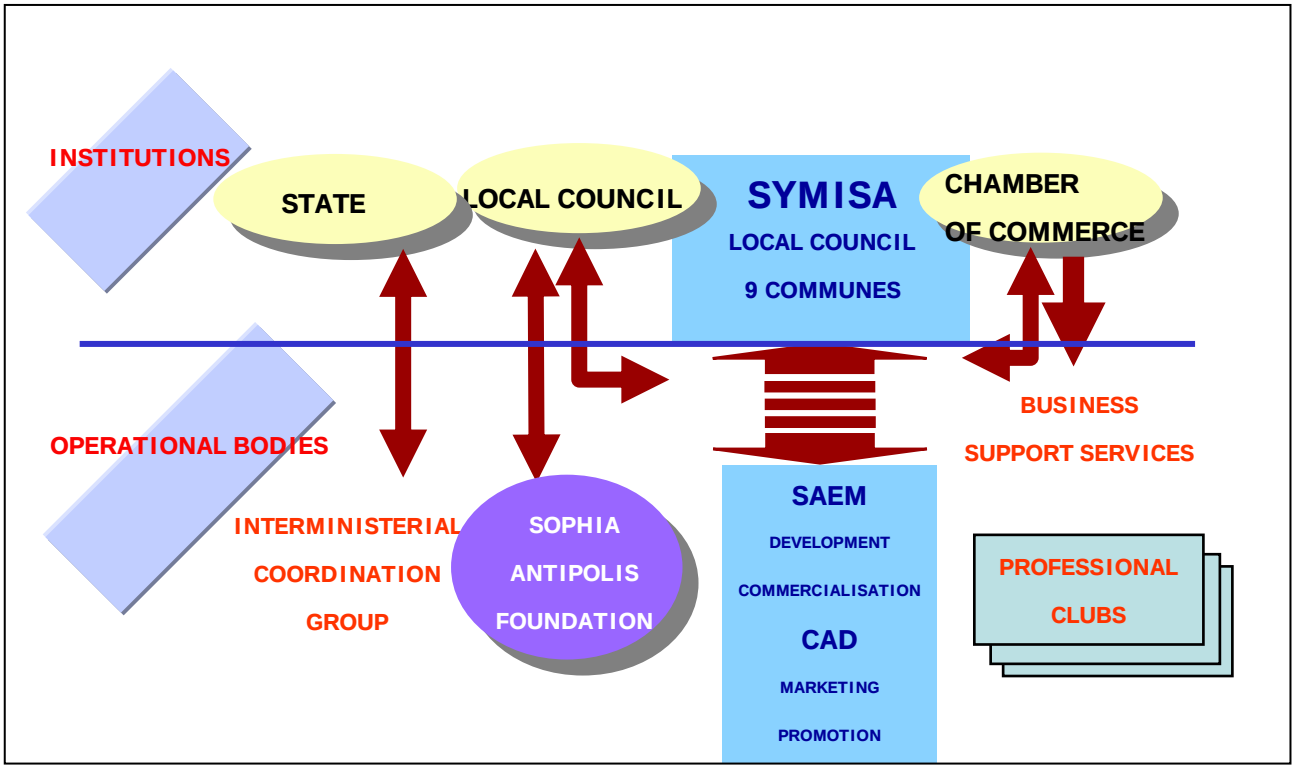



**Fig 6 Networks in Sophia-Antipolis**

Source: SAEM

## 2.4. Toyota City

### 2.4.1. Profile and Brief History

Toyota City is located in the center of Japan towards the Pacific Ocean, 3 km from Nagoya (the city was renamed from Goromo in 1959). Toyota City is the location of Toyota's headquarters as well as several factories and research institutes for the company.

Support from the city was essential for Toyota to begin business in Goromo. When Toyota looked for a location for its assembly plants, the municipal government decided to grant a subsidy that then amounted to 50% of the city's budget. After Toyota established its assembly plants, parts and machinery firms looking for business with Toyota flooded into Toyota City. At that time, Toyota did not have enough capital to establish plants for parts necessary to complete automobiles.

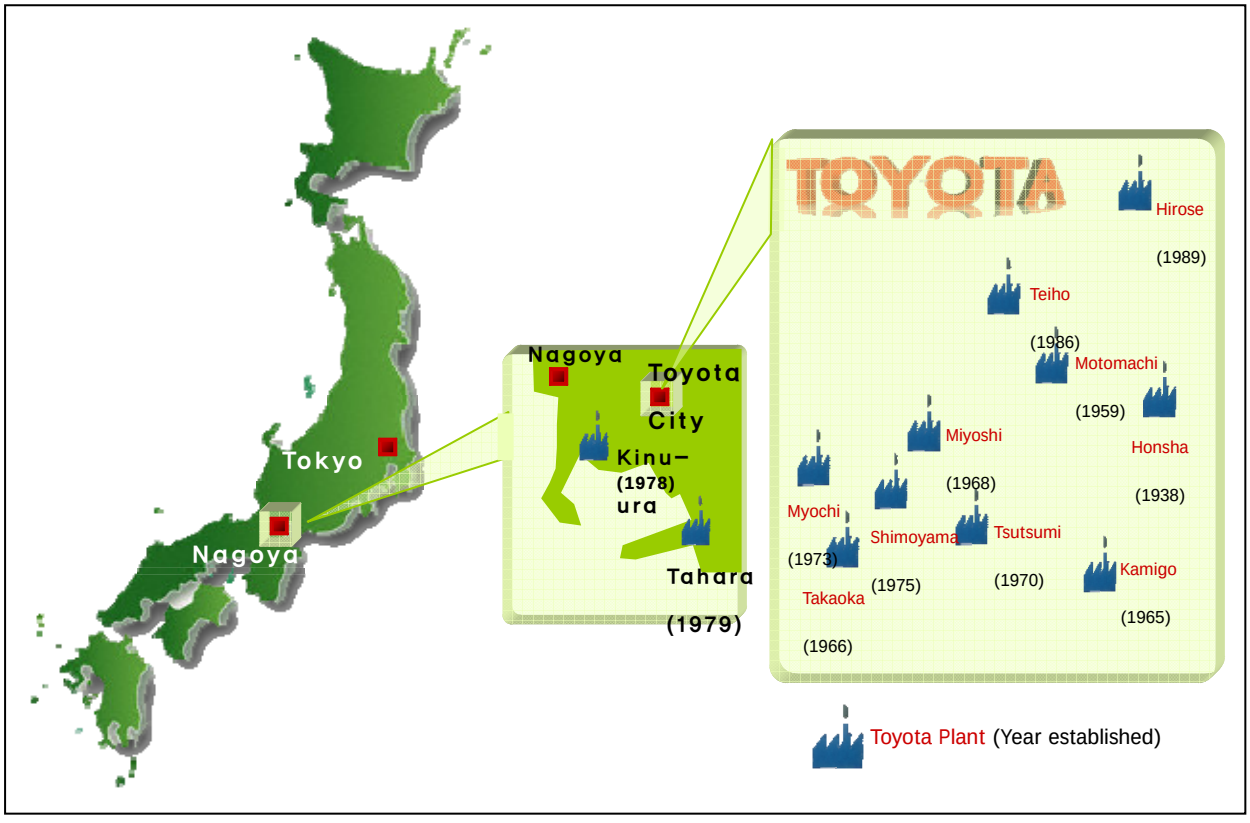



**Fig 7 Toyota's Plants in Toyota City**

Source: Harvard Business Review, 2007

### 2.4.2. Factors for Success

JIT (Just in time) production system was of primary importance in compelling part-manufacturing companies to locate near Toyota's factories. In the 1960's, Toyota deployed JIT in order to reduce inventory and to meet the needs of customers. The essential factor in

JIT is to deliver parts only as needed, making it necessary to locate near Toyota's factory due to the need to supply small quantities of parts frequently and on time. If delivery of parts was delayed, parts-manufacturing companies would be held responsible for the losses incurred from interruption to production.

Creating various knowledge networks is also an important factor for success. The most important networks that Toyota has created were (1) the Supplier Association, (2) Toyota's consulting division, (3) voluntary small group learning teams, and (4) inter-firm employee transfers (Dyer and Nobeoka, 2000). Using these networks as channels for circulating information and knowledge, Toyota managed to cut the costs and develop new technologies like hybrid car and fuel cell automobile. These four networks were able to efficiently circulate information and knowledge by utilizing various processes to transfer explicit and tacit knowledge in a multilateral or bilateral setting.

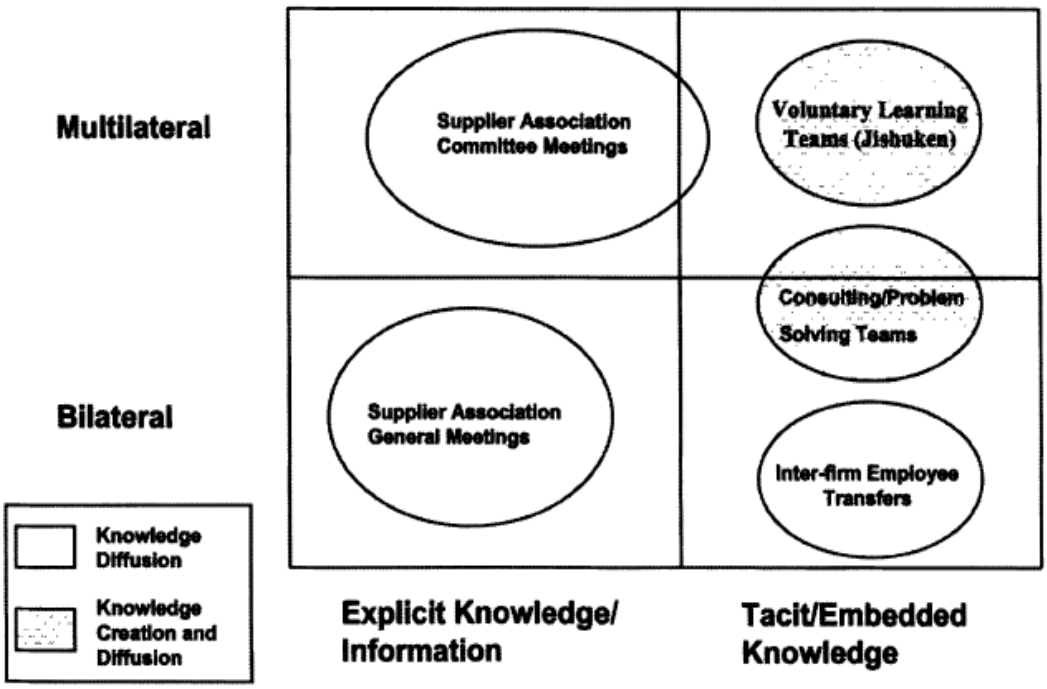



**Fig 8 Toyota's Knowledge Sharing Processes**

Source: Dyer and Nobeoka, 2000

**Supplier association**

Toyota established its supplier association in 1943 in order to promote mutual friendship and exchange of information between Toyota and its parts suppliers. The supplier association is a network-level forum for creating a shared community, including network norms, and sharing information (or explicit knowledge). The association has three purposes including: (1)

information exchange between member companies and Toyota, (2) mutual development and training among member companies, and (3) socializing events (Dyer and Nobeoka, 2000). Toyota divides the Supplier Association into three regions since suppliers must be in close distance to achieve the benefits of cluster formation.

There are two kinds of Supplier Association's meetings. The general meetings are intended to communicate explicit knowledge including production plans, policies, and market trends. Committee meetings are designed to communicate more complex knowledge on cost, quality, safety etc.

**Consulting/problem solving teams**

Toyota's operations management consulting division is a network-level unit assigned the responsibility to acquire, store, and diffuse production knowledge within Toyota's production network and was established in the mid-1960's to help solve operational problems at Toyota and its suppliers. Toyota's consulting division teams facilitate knowledge sharing by providing direct 'on-site' assistance to suppliers. The consulting teams typically stay at a supplier's plant for a period of time ranging from 1 day to many months. According to Dyer and Nobeoka (2000), on average, suppliers received 4.2 visits per year, and these visits lasted an average of 3.1 days.

**Voluntary learning teams**

In 1977 Toyota organized its key suppliers into voluntary study teams to assist each other with productivity and quality improvements. Each study group consisted of about 5~8 suppliers. The study teams are grouped on the basis of (1) geographic proximity, (2) competition (direct competitors were excluded), and (3) experience with Toyota (Dyer and Nobeoka, 2000). Each group was usually re-grouped every 3 years by Toyota to stimulate diversity and promote new ideas.

The process for the operating study group was as follows: (1) preliminary inspection, (2) diagnosis and experimentation, (3) presentation, and (4) follow-up/evaluation. Study group operated for 4 months with frequent visits from Toyota consultants. Toyota also held a year end conference where all the members of the study teams would meet together to share their experiences.

**Inter-firm employee transfer**

Inter-firm employee transfer also facilitates job rotations within Toyota's network and enabled the transfer of knowledge among Toyota and its suppliers. In Dyer and Nobeoka's survey, 11% of the

suppliers' directors were former employees of Toyota with 120~130 persons per year transferred to other firms within Toyota's network. These transfers were an important channel for sharing knowledge between Toyota and its suppliers, as transferred personnel brought knowledge of Toyota's human resources, systems, and technology.

To summarize, these four networks played an important role in sharing knowledge and facilitating frequent face-to-face communications among Toyota and its suppliers. The networks not only played a role in themselves, but also functioned as a system and complemented each other. In particular, study groups and consulting teams are not found in other automobile clusters.

Finally, it should be noted that these four networks were not established in a day, and Toyota spent more than 30 years and more to make these networks to function efficiently. In the early stage of cluster development, Toyota could depend only on weak ties between the companies and its suppliers, stronger relationships developing only gradually via the Supplier Association and its network of consultants. Suppliers strengthened their relationship by taking part in knowledge sharing meetings and received significant knowledge transfer from Toyota. While the flow of knowledge has remained unilateral from Toyota to its suppliers, the type of knowledge transferred now includes implicit one as well as explicit knowledge. The final stage of cluster development was to enable multilateral ties among suppliers and develop 'sub-networks' like voluntary learning teams. Today the flow of knowledge is increasingly bilateral with a significant degree of implicit knowledge is exchanged.

## 2.5. Hsinchu Science-based Industrial Park

### 2.5.1. Profile and Brief History

Hsinchu Science-based Industrial Park was initiated by the Taiwanese government in the 1970's. The governor of government had studied in San Francisco, and impressed by the success of Silicon Valley, tried to build a similar cluster in Taiwan. In the 1980's, the economy of Silicon Valley was sluggish, and some Taiwanese engineers were returning to Taiwan with more than 2,800 engineers coming back by 1997. They son spread Silicon Valley's culture of entrepreneurship into Hsinchu Science-based Industrial Park.

Hsinchu Science-based Industrial Park was built with an investment of NT $ 10 billion from the Taiwanese government. In 1989, 105 companies were already resident in the Park with about 20,000 jobs created there. To accelerate the development of Industrial Park, the government made a 10-year development plan in 1988 and tried to increase the numbers of companies and job offers. By 1997, the numbers of companies in Hsinchu numbered 245 with 70,000 employees. The Park was so successful that the Taiwanese government built a second science industrial park in 1995.

### 2.5.2. Factors for Success

The primary factors for success in Hsinchu Science-based Industrial Park can be summarized as follows; support from the government, networking among small and medium sized firms, participation from universities and research institutes, and linkages with Silicon Valley.

Hsinchu Science-based Industrial Park was spurred by the Taiwanese government which provided the main investments to build the park's infrastructure. Furthermore, the Taiwanese government offered benefits to companies in the Park in order to induce firms to locate there; including tax breaks, financing, and technological supports. The most important policy, however, was to actively encourage engineers from Silicon Valley to return to Taiwan.

Most companies in the Park were small and medium-sized companies specific to the IT industry, particularly computers and telecommunications equipments. The small size of firms and the fast pace of technological change in the industry made it necessary to encourage networks among small and medium-sized companies to help them produce the best products and services in the fastest possible time frame.

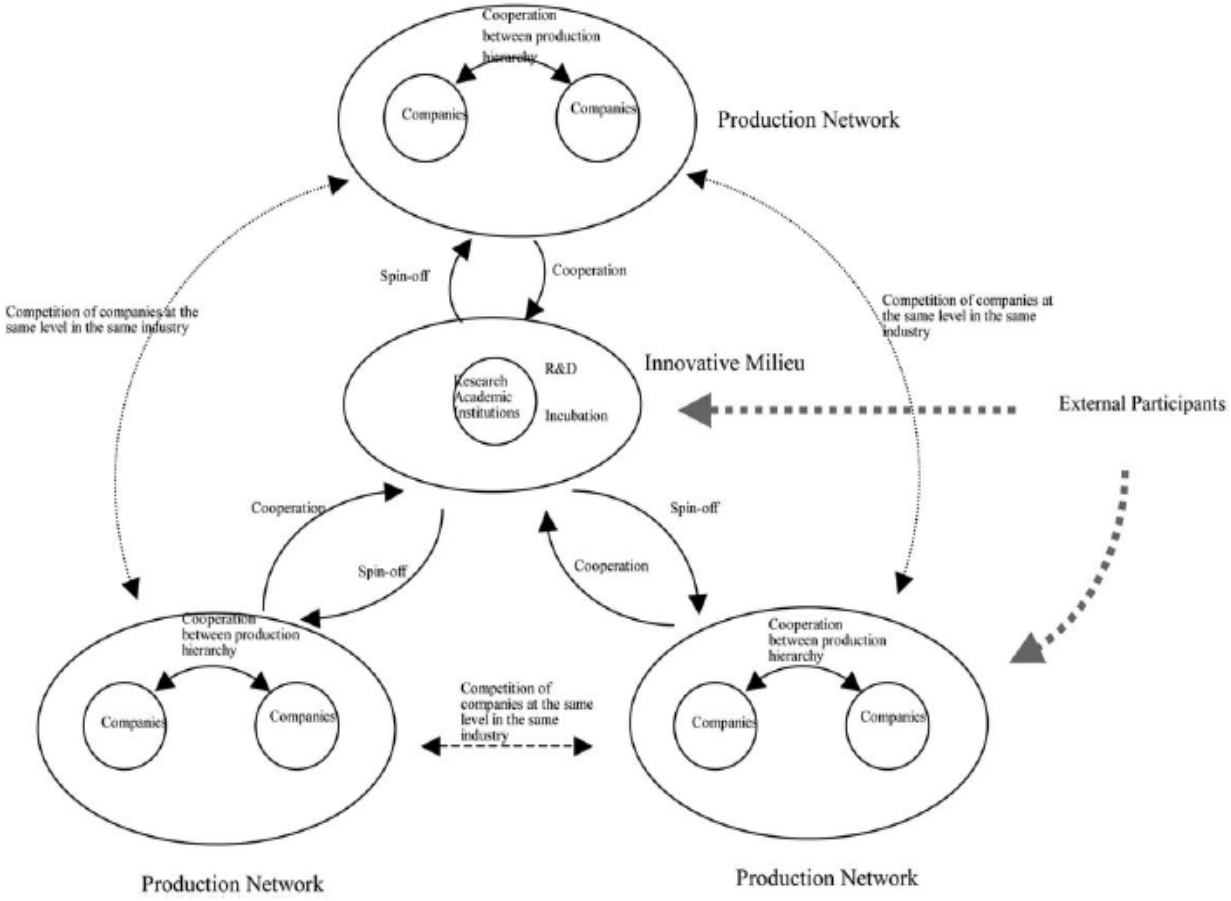



**Fig 9 Networks in Hsinchu district**

Source: T.-S. Hu et al., 2005

The support of two excellent engineering national universities and six national research institutes in the Park was also a very important factor for success. University research is deeply intertwined with the activities of companies in the Park with respect to research project, education, and co-operative studies. Research institutes operated by the government, like ITRI have also supported applied technologies.

Finally, relationships with Silicon Valley also played an important role as engineers moved from Silicon Valley could leverage not only their human resource networks but also their supply and demand networks. The situation evolved into a dynamic where Silicon Valley would develop basic science and technology, while Hsinchu Science-based Industrial Park developed and produced products and services based on Silicon Valley's work. Recently, China emerged as a world-wide center for production, and the network developed into a triangle of Silicon Valley for R&D, Hsinchu Science-based Industrial Park for development, and China for production.

## 3. Korean Clusters

### 3.1. Classification of Korean Clusters

This paper will also discuss the case for Korean clusters, i.e. Daedeok Science Park, Kuro Digital Industrial Complex, Tangjung Crystal Valley and Ulsan Auto Valley. The criteria for classification as such are largely similar to those in other industrialized countries, i.e. their main function (innovation-based vs. industry-focused) and stimulus for formation (market vs. government). Thus the Korean clusters correspond to the advanced clusters examined in chapter 2.

**Table 3 Cases of Korean Clusters**

| | |
|---|---|
| Innovative & Market-led Clusters: Kuro Digital Industrial Complex | Innovative & Policy-led Clusters: Daedeok Science Park |
| Industrial & Market-led Clusters: Tang-jung Crystal Valley | Industrial & Policy-led Clusters: Ulsan Auto Valley |

### 3.2. Daedeok Science Park

#### 3.2.1. Profile and Brief History

Daedeok Science Park, established in 1973 is the largest innovation cluster led by the Korean government. With its more than 30-years of history, Daedeok Science Park has the potential

to become increasingly innovation-oriented. It accommodates 63 research institutes from the public and private sectors as well as approximately 12,000 researchers with a master's degree or above. The facility accounts for about 10 percent of the total research manpower in Korea, and about 30 percent of the country's R&D. Currently it has gained attention for its world class research results, registering around 30,000 patents in Korea and abroad. In 2004 the Daedeok R&D Special Zone was enacted to promote commercialization of R&D results and in 2005 the Daedeok Innopolis Agency was established as the managing organization for the area.

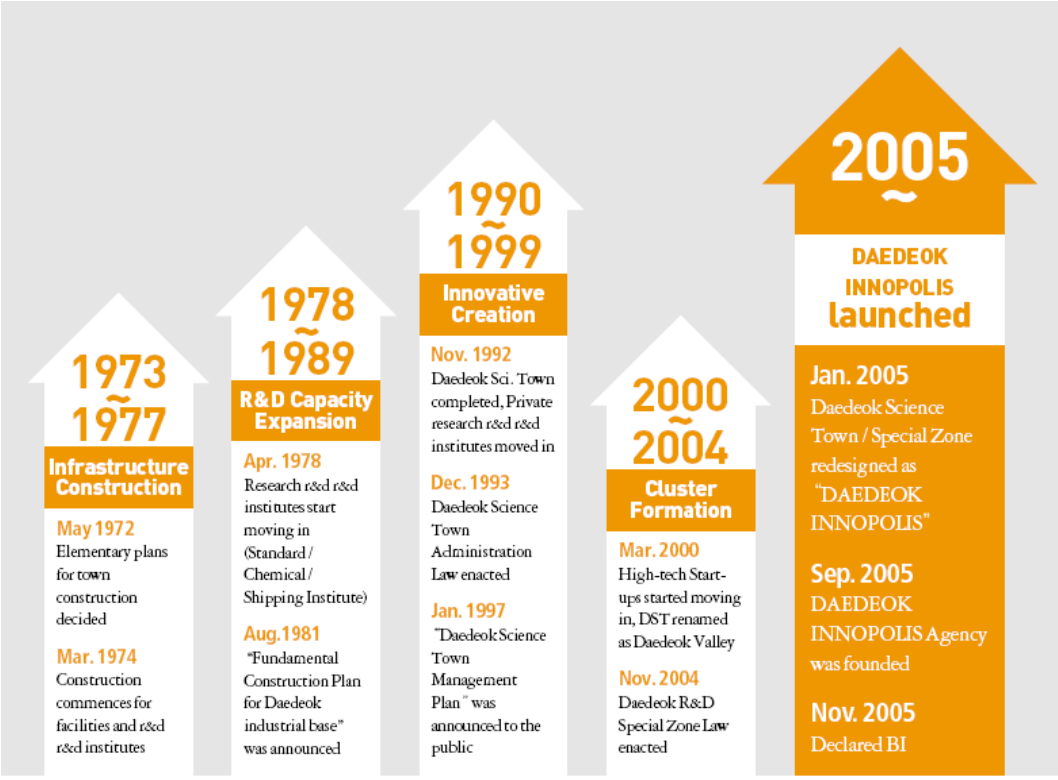



**Fig 10 Evolution of Daedeok Science Park**

Source: Daedeok Innopolis Agency

### 3.2.2. Factors for Success

Startups began in Daedeok Science Park right before the economic crisis in the mid 1990's. Before that time, Daedeok had concentrated only on Research and Development functions, as it originally been intended solely for R&D and education rather than industry. After the TIC (Technology Innovation Center) and TBI (Technological Business Incubator) were formed at KAIST in 1994, however, startups were increasingly active in the area. After the mid 1990's, startups increased as support policies from the Daejeon city government became active and after TBI was extended. In 1999, a law allowing the entry of manufacturing firms into

Daedeok was enacted.

The specific stimulus that enabled startups to appear in Daedeok was actually mass layoffs from research institutions operated by the government. After the Asian financial crisis, layoffs and divestments increased while supports for startups by the government expanded. There are 22 TBI arrangements with more than 400 companies, with an active TBI transition program to smooth the transition for companies that have graduated from their TBI to Daedeok. Typically, a support complex is formed for startups to resolve with respect to marketing, production, storages and exhibition, etc.

The Ministry of Science & Technology and the city of Daejeon plan to make Daedeok Science Park into the leading technology cluster in South Korea, encompassing firms, universities and research institutes. The act on the Special R&D Zone for Daedeok passed the National Assembly in December, 2004, which aimed to link R&D and startup establishment by utilizing the assets of R&D assets accumulated over the past 30 years. After the promulgation of the act, the Daedeok Innopolis Agency was established as an office for management of the area. Daedeok Innopolis has tried to transform Daedeok Science Park into a world class cluster by commercializing R&D, networking & dissemination, and provision of a global business environment.


**Fig 11 Vision of Daedeok Innopolis Agency**

Source: Daedeok Innopolis Agency

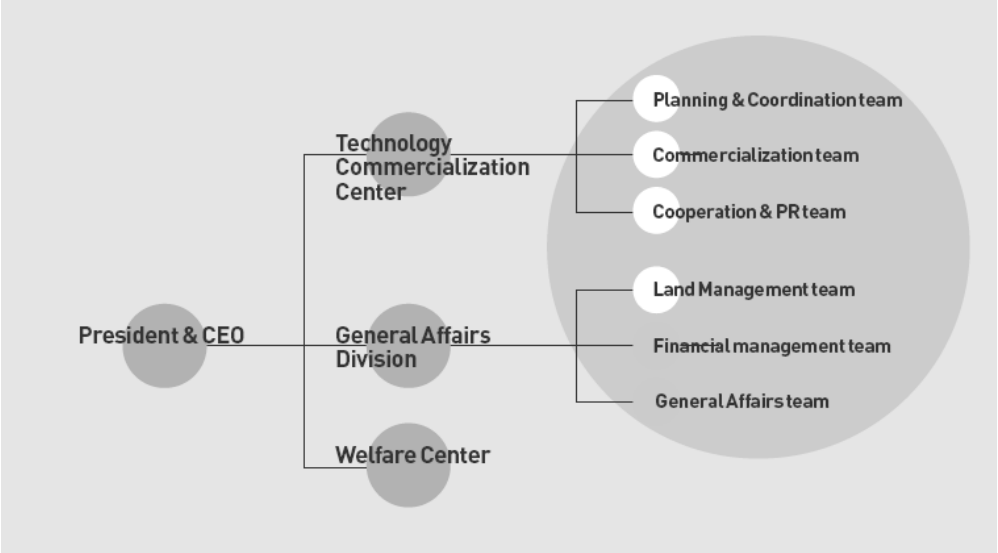



**Fig 12 Organization of Daedeok Innopolis Agency**

Source: Daedeok Innopolis Agency

## 3.3. Guro Digital Industrial Complex[6]

### 3.3.1. Profile and Brief History

Guro Digital Industrial Complex is a good example of success in transforming an old industrial complex into an innovative cluster. The outdated and once almost-abandoned industrial complex has redeveloped itself into the one that provides large business spaces at low prices, successfully attracting state-of-the-art industries and turning it into the incubator of new high-tech businesses (Park, 2007).

Guro Industrial Complex in Seoul, Korea's first industrial complex founded in the year of 1965, was once decrepit due to the loss of competitiveness of factories against China. But it is now gradually transforming into a 'within-a-city business park' undergoing a noticeable quantitative and qualitative expansion. Factories equipped with cutting-edge IT infrastructure and pleasant working environment fill the complex, developing a used-to-be smokestack industrial complex into one filled with environmentally friendly facilities. Particularly, apartment-type factories, which are high-rise buildings with numerous offices, are leading the complex's renovation.

[6] This section is based on the work of Park (2007).

**<1970's>** **<2000's>**

**Fig 13 Past and Present of Kuro Digital Valley**

Over the past decade, the number of firms in the complex has increased as much as 14 times and the number of employees increasing nearly 3.7 times. As of April 2007, 6,711 companies with 92,000 workers operate at Guro.

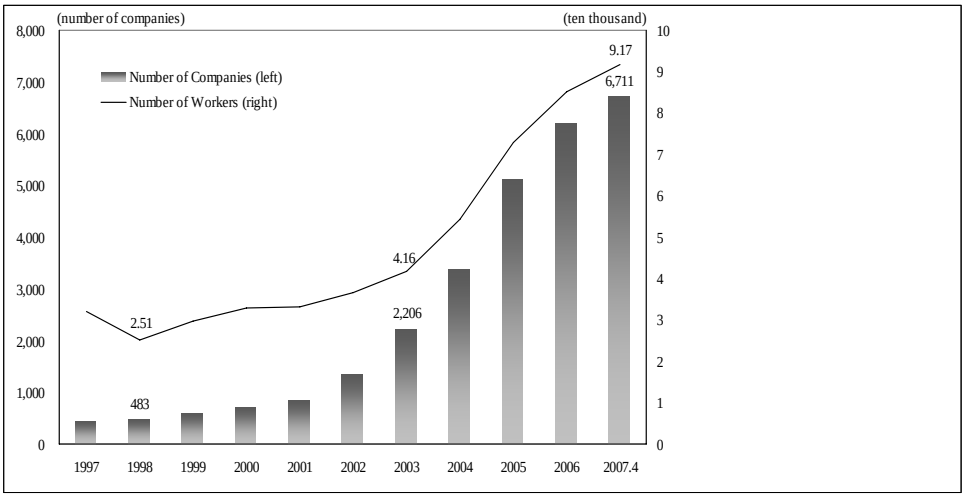



**Fig 14 Numbers of Companies and Workers in the Guro Digital Industrial Complex**

Source: Korea Industrial Complex Corporation

### 3.3.2. Factors for Success

Core success factors of Guro come down to the following three, including ① low regulation and low cost, ② geographic comparative advantage and ③ network effects (Park, 2007). Deregulation in the Seoul metropolitan area has played the decisive role in the success of Guro as it led to a supply of inexpensive apartment-type offices, helping meet the business needs of IT startups. At present, Guro Digital Industrial Complex has 61 apartment-type factories, more than any other industrial area. Also, regulations banning non-manufacturing

companies from entering the complex were also lifted, opening the complex for IT industries.

Guro's natural strength lies in its access to the knowledge infrastructure of the Seoul metropolitan area, where Korea's largest market with abundant high quality workforce, technology and capital. Additionally, the complex functions as a node of transportation, making human and goods movement convenient. It offers easy access from anywhere in Seoul as well as Incheon (the third largest city) and Gyeonggi province (the province surrounding Seoul) so that high-skilled and frontline workforces can go to and from work conveniently.

Firms in the industrial complex have enjoyed network effects throughout synergy among firms and institutions in the complex. Manufacturers of molds, parts and materials are old residents in the complex, and nearby shops selling tools create synergy with small- and mid-sized startups when they try to produce product prototypes. Due to division of labor between startups and existing manufacturing companies, the former can focus on their core capabilities of R&D and the latter develop into more value added functions. Indeed, in a job satisfaction survey in the complex, the largest group or 20.0% of the total respondents said, "Working with partner companies in the complex together makes things easier." Also, about 29% of respondents said they are enjoying synergy and nearly a half said they expect so.

Guro Digital Industrial Complex is a 'within-a-city corporate ecosystem' created largely by companies, with government support. Traditional manufacturing companies lost competitiveness and gave way to private construction companies, which then they built apartment-type factories and have consequently induced SMEs and venture capital companies. Thanks to this, the complex is enjoying many economic advantages as a cluster, including economies of scale, cost cuts, and a range of business opportunities. The government also helped reinvigorate the complex through deregulation and tax incentives, perhaps, recognizing the importance of the complex as the only national industrial complex located in Seoul.

However, in order to develop further, it is imperative for Guro Digital Industrial Complex to become a flexible cluster for knowledge and technology creation. To this end, the Korea Venture Business Association, the Korea Industrial Complex Corporation and community service providers strengthen community functions like forums, conventions and joint training exercise in the complex. Improvements should also focus on infrastructure in order to boost firms' innovative capabilities. Another urgent task is to build amenities for workers and visitors in the complex including shopping centers, general hospitals, cultural centers, convention centers, and business hotels.

## 3.4. Tang-Jung Crystal Valley

### 3.4.1. Profile and Brief History

Tang-Jung Crystal Valley was officially christened on June 23rd 2004. “Crystal Valley” refers to its function as the main source of LCD panels.[7] LCD panel factories and related parts-makers and material providers including glass manufacturers, are clustered around A-San and throughout Cheon-Ahn province.

As the size of LCD panel becomes larger and larger, companies needed to be located within a one hour distance to reduce transportation costs. Equipments in the LCD industry must also be installed with the cooperation of several firms, enabling speedy resolution of problems, always a key factor in the LCD industry. Clusters have likewise formed around LCD-panel companies that include several related firms.

**Fig 15 A Picture of Tang-Jung Crystal Valley**

### 3.4.2. Factors for Success

[7] A liquid crystal display (commonly abbreviated LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector (http://en.wikipedia.org/wiki/Liquid_crystal_display). It is prized by engineers because it uses very small amounts of electric power, and is therefore suitable for use in battery-powered electronic devices.

The main factor in the successful formation of Tang-Jung Crystal Valley over relatively short periods of time has been the rapid and substantial investment from LCD-panel companies. Investments from Samsung Electronics in the LCD panel played a key role in the formation of the cluster, as LCD-panels from Samsung Electronics became ubiquitous in laptop computers during the late 1990's and the early 2000's. Conditions in the market were positive as growth in the LCD TV market increased rapidly. The market for LCD TVs grew to 4.9 millions this year, and is predicted to go over 100 million in 2009.

Support from local government was one of the most influential factors. While the timeframe of construction is usually about 36 months; it took only 13 months to construct Crystal Valley. Timing is very important in high-speed industries like LCDs and support from the local government has been critical in shortening time to time. Cooperation among firms and research institutes soon followed, with universities around Crystal Valley, opening display related courses and modifying their curriculum.

Improvements in the quality of life in Crystal Valley also proved very important, with the mayor of ASan changing the city's slogan of city from the 'Spa-tour city' to the 'Education & Culture city'. High quality schools will be built in Crystal Valley and cultural events like musicals and operas have increased their presence.

## 3.5. Ulsan Auto Valley

### 3.5.1. Profile and Brief History

Ulsan has been the country's largest automobile industrial cluster since Hyundai Motors founded its first factory there in 1968. Hyundai's Ulsan factory, one of the world's largest, produces 5,500 cars per day and 1.5 million cars per year, accounting for 27% of the national production of automotive vehicles. Ulsan's local economy is dominated by the automobile industry with 54.8% of employees living in Ulsan working for the automobile industry or related industries. Although Hyundai would construct assembly plants in other areas in the 1990's, Ulsan still maintains its status as the number one automobile cluster in Korea.

Hyundai's Ulsan factory was started by producing Ford's 'Cortina' in 1968, producing its first original model the 'Pony' in 1975. Hyundai would later produce its 'Alpha engine', the first engine developed by Korean engineers in 1991.

### 3.5.2. Factors for Success

The diver of Ulsan's transformation from a quiet fishing village to the country's dominant automobile cluster was government policy. At the time, the Korean government tried to

increase exports of heavy industrial products like automobiles, chemicals, and ships, and for that purpose the government planned to form an industrial complex on the coast in order to take advantage of easier transportation. Since Ulsan is located very near the sea, an industrial complex for cars, shipbuilding, and oil & chemicals was built there.

Hyundai was the main factor responsible for the formation of Ulsan Auto Valley. At that time domestic companies did not furnished sufficient technology and capital to create an industrial cluster. However, the enterprising spirit of Korean firms, especially Hyundai, combined with foreign technology and cheap domestic labor proved to be a successful combination. Government backed firms used loans from other countries to supply the capital to Korean companies. Applying he maxim ‘Learning by Doing’, Hyundai developed technologies imported from foreign countries and finally created its own car, the ‘Pony’ in the early 1970’s. Cooperation with parts companies was also an important factor with parts companies supporting the production of high-quality and low-priced automobiles.

Ulsan Auto Valley developed into a “hub-and-spoke” cluster with Hyundai acting as a hub and with parts companies acting as spokes. This type of network is often criticized as inefficient in circulation of information and knowledge as the network is closed and dependent on a hub. However, in earlier times in Korea’s automobile industry, this type of network increased the efficiency of production as parts makers could get the assistance form the hub firm that would not allow the technology information to be diffused to other competitors.

Nevertheless, parts manufacturers in Ulsan are still regarded as simple producers entirely dependent on Hyundai. Additionally, the cooperation network between the suppliers and Hyundai is not well established enough to enable the sharing of tacit knowledge. Ulsan is accordingly not capable of creating the desired knowledge and innovation that typify an industrial cluster at present. Moreover, since Hyundai Motors transferred its R&D center to Namyangju in Kyeonggi province, Ulsan now function simply as an assembly and production cluster with weak R&D.

To overcome these weaknesses, local governments in Ulsan and the Ministry of Commerce, Industry and Energy (MOCIE) have set forth a plan called the “Ulsan Auto Valley.” Under this plan, Ulsan will develop into a genuine automobile cluster composed of various facilities, including the Automotive Parts Innovation Center [8] (to help expedite technological development of auto parts manufacturers), the Parts Materials Complex, the Modulation

[8] The Automotive Parts Innovation Center is an institute that comprehensively supports the automotive parts industry, established jointly by the City of Ulsan and the Ministry of Commerce, Industry and Energy.

Complex, and the Auto Plaza that will house functions like automobile-related marketing, exhibitions and public relations facilities.


**Fig 16 The Plan of Ulsan 'Auto Valley '**

Source: Automotive Parts Innovation Center

## 4. Policy Guidelines for Cluster Development[9]

[9] In contrast with the many studies on clusters, there are comparatively few studies to explain practical guidelines for clusters. "A governors' guide to cluster-based economic development" published by the national governors association in 2003 will be one of them. Recently the national governors association with council of competitiveness publishes another report about clusters, "Cluster-Based Strategy for Growing State Economies," under the auspices of the council of competitiveness in 2007. A good guide for best practices can be found under 'Guidelines for developing a biotechnology cluster innovation plan' published by the Ministry of Enterprise, Opportunity and Innovation, Ontario, Canada, in 2003. Though the plan focuses on the biotechnology, procedure and structures in the report are applicable to other industries as well. Advices on clusters can also be found in the website of the competitiveness

The policy guidelines for cluster development suggested here involve a few simple procedures, i.e. “Plan,” “Do,” “See.” Considering Korea’s experience, we have add ‘education & benchmarking’ procedures that can increase the efficiency and effectiveness of the cluster policies.

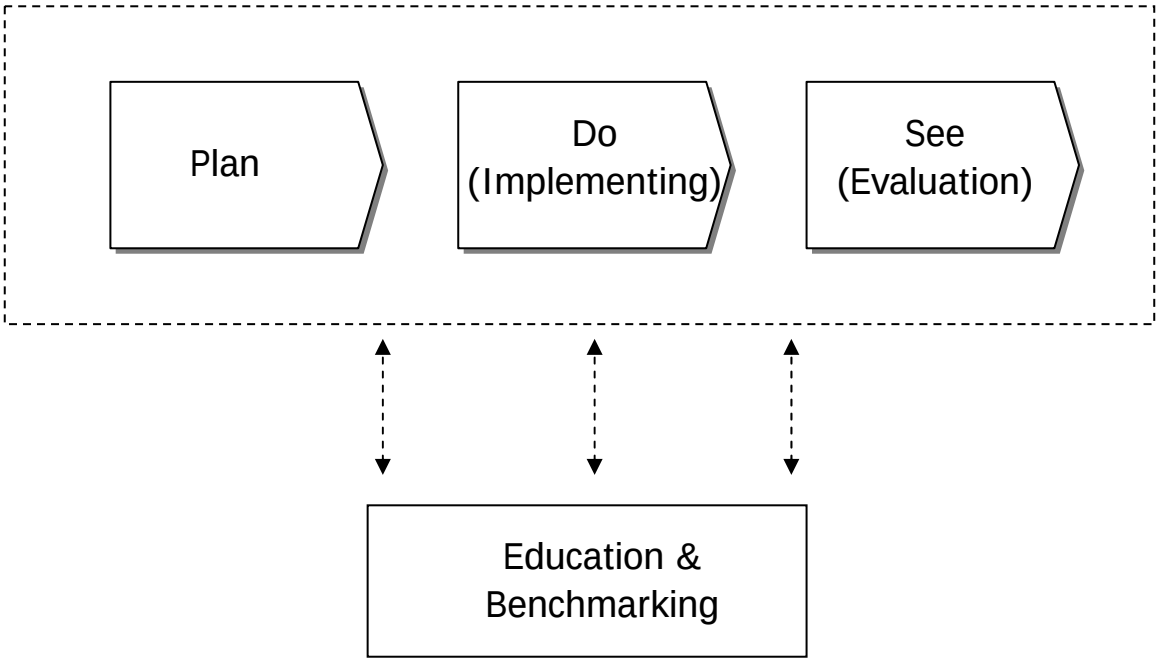



**Fig 17 A Procedure of Cluster Policy**

## 4.1. Cluster Planning

### 4.1.1. Regional Resource Profile

The first step in cluster planning is to identify the resources of region that will be the base of cluster. The purpose of writing down the resource profile is to identify key regional strength and weaknesses. The regional resource profiles will outline the innovative assets within the region and understanding region’s assets industry base like workforce, skill base, universities and research institutions will determine the region’s strengths and global competitive advantages.

The regional resource profiles include (1) community and area profile, (2) industry profile, (3) education and skills profile, (4) research & development profile, (5) transportation and telecommunication infrastructure, and (6) natural resources and specialty infrastructure. At the end of the profile, SWOT (strength, weakness, opportunities, threats) analysis is developed.

---

institute (www.competitiveness.org): "A practical guide for developing clusters" by the UK Department of Trade and Industry (DTI) in 2004; and “The Cluster Policies White book” by IKED (International Organization for the Knowledge Economy and Enterprise Development) in 2004 etc.

**Community and area profile**

The profile of the community and area should include total area and population (compared with other areas), and population statistics (trend of 10-year growth rate). The profile should have the physical infra-structure lists, including total land available for commercial development, number of research parks, commercialization centers, and incubators. For each infrastructure, detailed information on size of facility, tenant companies by sector, available space, and service provided should be described. At the end of community and area profile, existing economic development or innovation plans (developed within the last 3 years) should be attached.

**Industry profile**

Industry profile in cluster planning includes total employment and unemployment rate, and the weight of an industry in a cluster. For each major industry sectors, the following statistics are needed to be compiled:

- Life cycle of industry (i.e., emerging, nascent, mature, declining)
- Numbers of companies and employees (trend data over 10 years) / Anchor firms
- Key growth factors / Average wage rate
- Total R&D investments
- Total sales / domestic and international market shares / total exports, % of global market
- Expected growth rate within five years
- Key collaborations / alliances
- Determine location quotient factor10

**Education and skill profile**

On the list of education and technology profile, numbers of universities and colleges and their students and enrollment rates of each department should be described over 10 years period. Other relevant educational training facilities are also recorded with following information:

- Number of science, engineering, business degrees/diplomas granted
- Number of PhD scientists, engineers and MBAs employed in the region

---

[10] Location quotient is the ratio of the share of regional employment in a particular sector to the share of national employment in that sector. Location quotients can be interpreted by using the following conventions:

(1) If LQ>1, this indicates a relative concentration of the activity in the area, compared to the region as a whole.

(2) If LQ =1, the area has a share of the activity in accordance with its share of the base.

(3) If LQ<1, the area has less of a share of the activity than is more generally, or regionally, found.

- Number of collaborative programs

**Research and development profile**

On the field of research and development, lists of research institutes, total amount for projects, and the source of the funds, special equipments list must be included. Amount of R&D funding by source of R&D funding (government: federal / provincial / international; private sector: regional / national / international) is also needed. For each research institute, the following information by discipline/research area should be compiled:

- Total value of scientific research conducted (10 year timeline)
- Number of invention disclosures (10 year timeline)
- Number of patents (10 year timeline)
- List of key researchers
- Number of spin-offs created (10 year timeline)
- List industrial collaboration
- Technology transfer infrastructure

**Transportation and telecommunication infrastructure**

Data of transportation and telecommunications infrastructure is needed with the state of transportation infrastructure, availability of broadband and internet services and number of telecommunication providers, levels of services and prices of them.

**Natural resources and specialty infrastructure**

If possible, it is necessary to identify and quantify resources of the region. For each resource the following information is needed;

- Type
- Source
- Location
- Quality
- Transportation required

**Regional SWOT analysis**

SWOT analysis using the data collected in the aforementioned regional innovation profile is needed. The SWOT analysis utilizes the following current and future economic data:

-State of the economy (stage of economic cycle: recession, etc)

- Demographic shift
- Labor/workforce issues

- Government policies and pending legislation
- Change in technology
- Consumer changes/trends

The SWOT analysis will reveal strengths and weaknesses of the region. If particular fields are known to be relative regional strength, then proceed to next step of setting the goals.

### 4.1.2. Setting the Goals

After identifying regional resources, further considerations for clusters involve the setting of goals. Planners must describe objectives for the details and boundaries of the cluster. After delineating physical boundaries, clusters require an outline of the networks and constituent elements therein that link to each other synergistically. To identify these elements, one must identify the entities responsible for developing the cluster. Thereafter, a vision statement supported by all stakeholders is requisite to describe the desired conditions in 5 or 10 years. A mission statement that sets measurable goals and objectives for the short-term, mid term, and long-term will also be necessary.

Some considerations are needed when setting goals for clusters. First, every member in a cluster should agree on overall goals to prevent problems from occurring in the future. Even though this process takes substantial time and effort, such goals should be induced through reasoned discussion and persuasion. And needlessly to say, the process of discussion and persuasion must be clear and fair. Second, goals should be based on a region’s strengths as can be inferred from the previous explanations of successful clusters. If a cluster is not formed based on its inherent strengths, it will be difficult to gather the needed firms and institutions, and the cluster will not be sustained. Third, a global perspective will be necessary since most industries are already internationalized. Not only domestic clusters but also international ones need be reviewed, while networks with other regions and countries must also be taken into consideration. Finally, clusters need staged policy goals with a long-term view. As mentioned in the case studies, formation of a cluster requires significant investments of time, as cooperative networks require substantial experiences and interaction. Successful clusters will never be built in a day.

## 4.2. Implementing Cluster Policy

### 4.2.1. Roadmap for Cluster Implementation

After analyzing resources and setting the goals, further roadmaps for prospective clusters will

be required. The road map should be arranged as projects staged for the short-term (1~2-year), mid-term (2~5-year) and long-term (5~10-year), with each step including detailed explanations on how to perform action plans successfully. Furthermore, roadmaps also provide an organizational structure that can enhance implementation, including a detailed budget that denotes the support provided by members and stakeholders.
From the foregoing case studies, organizations should clearly be based on regional members who know about the area and can establish detailed strategies. To enable more effective cluster policies, organizations should include the core members in the region. Organizations that manage clusters come in various forms. The central government can be the main organization, as is the case in Korea and Japan. In the case of Europe, the local government functions as the main impetus. Organizations also vary in their legal status. Some organizations that function as de facto clusters are operated by the government; others are mixed with public/private organizations; while still others are 100% private organizations. The character of organizations depends on the historical and cultural backgrounds of the regions.

### 4.2.2. Implementation Plan

Clusters require a number of actions to be successfully implemented. This implementation plan will identify some near term milestones that clusters need to achieve. The implement plan includes the following components;

- project description
- rationale or justification
- financial plan
- marketing plan
- operational plan
- support for the project, partnerships, and collaborations, synergy and linkages with regional and external resources and infrastructure

Special care is needed on the following points. First, as shown in the case studies, networks between firms and institutes are the most important factor in getting clusters to succeed. Hence, a successful implementation plan should furnish systems of networks that create new technology and knowledge or business models continuously, based on the active interchange of information and knowledge. When promoting networks, informal and casual meetings need to be given equal status to more formal networks. Informal network activities should not be regarded as options that complement the formal network, and instead should be regarded as equivalent to official network activities.

Second, if the implementation plan requires government support for the development of physical infrastructure, a detailed business plan must be submitted. When regions start to implement cluster policy, they tend to ask for the local or central government to supply the physical infrastructure first without devising appropriate business plans or evaluating the financial sustainability of the proposed infrastructure. Before asking for the construction of expensive infrastructure, business plans that demonstrate financial viability are absolutely necessary.

### 4.3. Evaluation

To guarantee the transparency and responsibilities of cluster policies and to contribute increasing international competitive power, an evaluation system that analyzes the overall process and achievements of cluster policy is needed. Through this evaluation system, omissions and errors can be adjusted while successful examples can be shared among personnel, ultimately helping to drive more effective cluster policies. Evaluations also allow personnel in each region to compete with each other to improve results.

When implementing evaluation, identifying key performance indicators is required such as;

- Economic Indicators: number of start-up companies, number of new direct and indirect jobs, increased sales and exports, venture capital invested, R&D investment attracted, tax revenue generated, etc.
- Human Resource Development Indicators: number of entrepreneurs, number of business training seminars or mentorship, etc.
- Commercialization Indicators: number of patents awarded, number of technologies licensed, university revenue from licensing agreements, etc.

Several things should be considered when building an effective evaluation system. First, evaluation should be performed by an independent organization that is separate from the evaluated organization. Second, basic evaluation plans should be set in advance so that evaluated organizations should know about the evaluation plans before they are assessed. Third, the evaluation results should be used to reflect incentives and improvements in policy to induce more effective actions on the part of personnel who perform the policy.

### 4.4. Education and Benchmarking

#### 4.4.1. Education

To guarantee an efficient and effective results from cluster policy, every member, whether they participate in policy management directly or indirectly, should have basic knowledge

about the cluster policy. In particular, since the cluster policy differ from industrial policy or science-technology policy, education will be mandatory.

Education on clusters can convey the backgrounds, goals, and factors for success, as well as providing successful case studies. Education will lead to greater understanding and more active participation in cluster policies so that the efficiency of the policy can be increased.

Accordingly, cluster education programs should be performed as a dialogue, rather than just a unilateral indoctrination. Through discussions, participants can more clearly perceive what they wish to obtain from education, while programs can be established and managed according to their needs. Furthermore, education programs that describe real situations should be developed to minimize the gap between academic theory and real world practices. Even if outstanding programs are offered, such programs are meaningless if they do not actually provide participants want. Therefore, during and after the education programs, evaluations of the level of participants' satisfaction should be performed to increase the quality thereof.

### 4.4.2. Benchmarking

One important method to improve the policy is to find and analyze successful examples and distribute expertise to other members. There are several methods to benchmark successful examples in cluster policies.

First, the hosting of conferences, exhibitions and tournaments where members performing cluster policies can meet and examine the performance of other members can be an effective means to improve policy and exchange information. Second, management expertise on the promotion of clusters should be published in the form of white papers. Third, databases should be devised to maximize achievement and to pool and develop shared knowledge.

## 4.5. Final Remarks

### 4.5.1. Characteristics of Cluster Policy

First, there is no universal cluster policy which can be applied indiscriminately to all regions (Raines, 2002). The OECD's study on clusters (1999, 2001) concluded that simply copying and applying cluster policies does not, *in se*, guarantee success. In this sense, cluster policy should be unique and reflect the particularities of each region's environment.

Second, as the OECD study (1999, 2001) emphasized, the cluster policy can overlap with various other policies including industrial policy, regional development policy, and science & technology policy. It is thus essential to have a system that can coordinate activities between different policy areas.

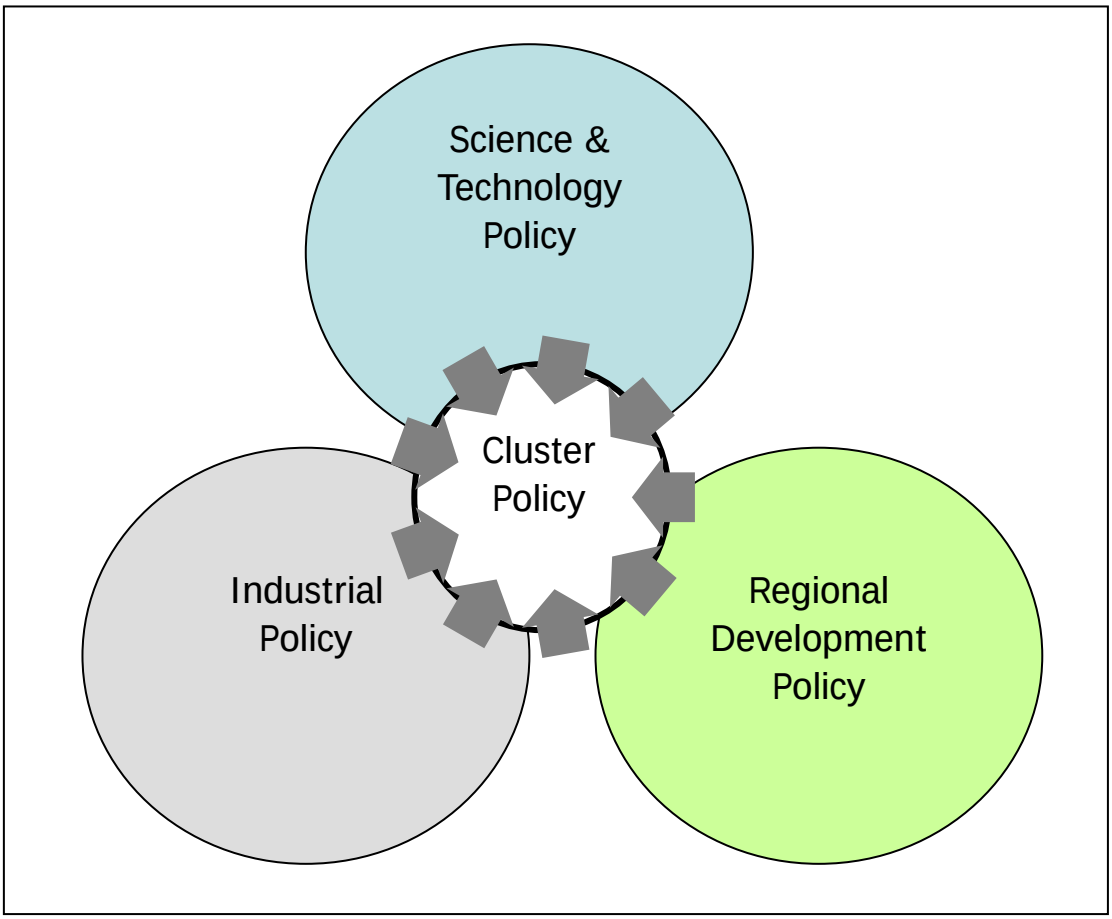



**Fig 18 Characteristics of Cluster Policy**

Third, the focus of cluster policy should be on the formation of active networks among companies and institutions. In clusters, networks among large and small-and medium sized firms, and cooperative projects between firms and universities/institutions are more important than solving problems of individual entities.

Fourth, some researchers have noted that the participation of private firms in formulating cluster policies may be the main factor to forming a successful cluster (Nauwelaers, 2003). Education, preparation of statistical data and research funds etc. are usually treated as a function of government, but in a cluster, private firms actively participate and offer these public goods also (Porter, 1998). Therefore, provision of incentives to the private firms to participate in formulating policy, could be a very important factor in determining a cluster's success.

### 4.5.2. Final Notes

When a particular region initiates a cluster policy, such policy tends to include all the items

that comprise a cluster. However, a cluster is not in fact an autarky.[11] It is actually uncommon for a region or a country to have all the resources necessary to form a cluster, and even though it has, there is no guarantee that such resources will be very competitive vis-a'-vis other regional rivals. Focusing on the strengths of the region and networking with other regions is a more viable way to create a successful cluster.

Furthermore, formation of a cluster is by no means a cure-all-measure simply a means of solving regional problems (Nauwelaers, 2003). There is no definite evidence about the effects of clusters. The studies to analyze the effects of clusters report different results so far (Nesta et. al., 2003).

Clusters can also lead to excessive dependence on a single industry, and such dependence can cause the region to suffer from lock-in, i.e. the inability to adapt to changes in the global environment. The watch industry cluster in Switzerland, for example, was paralyzed by a group-think influenced attachment to traditional technology in the 1980's. Such lock-in led to a nonchalant attitude towards the effects of digital technology on the watch industry, which continues to experience difficult times on the low-end and mid-range levels (Glasmeier, 1991).

It is also important to guarantee the high quality of life, which encourages talented people and their families to gather in a cluster. For example, Kista Science Park in Sweden changed its name from Kista Science Park to Kista Science City in 2001. Changing 'Park' to 'City' may seem immaterial, but such a nominal shift is actually very meaningful. A 'Park' is a place to relax from time to time, but a 'City' is a place for people to work and live 24 hours a day. Changing the name to City indicates that the cluster's custodians will manage the city as a convenient place for people to live, rather than simply a place for companies to enjoy good access to services. A cluster should accordingly provide an environment that is suitable not only for running business but also for providing high quality of life.

Finally, forming a successful cluster might not be enough to foster regional development. In this era of globalization and hyper-competition, clusters have become numerous all over the world. Outpacing other regions may ultimately require more than the simple formation of a cluster to succeed.

[11] An autarky is a closed economy that limits trade with the outside world, or an ecosystem not affected by influences from the outside, and thus relying entirely on its own resources.

## 5. References

Altenburg and Meyer-Stamer, “How to Promote Clusters: Policy Experiences from Latin America,” World Development 27(9), pp.1693-1713, 1999

Dyer, “Dedicated Assets: Japan's Manufacturing Edge,” Harvard Business Review (Nov.-Dec.), pp. 174-178, 1994

Dyer and Nobeoka, “Creating and Managing a High-Performance Knowledge-Sharing Network: the Toyota Case,” Strategic Management Journal, 21(3), pp. 345-367, 2000

Glasmeier, “Technological Discontinuities and flexible production network,” Research Policy 20, pp. 469-485, 1991

Harvard Business Review, “Lessons from Toyota's Long Drive,” The HBR Interview/Katsuaki Watanabe, July-August 2007, pp. 74-83, 2007

IKED (International Organization for the Knowledge Economy and Enterprise Development), The Cluster Policies Whitebook, 2004

Joint Venture: Silicon Valley Network, Index of Silicon Valley, 2007

John, Carvon H. ST., and Pouder, R. W., “Technology Clusters versus Industry Clusters: Resources, Networks, and Regional Advantage,” Growth and Change Vol. 37 No 2, pp. 141-171, 2006

Lee, C,-M., W. Miller, M. G. Hancock, and H. Rowen, “The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship,” Stanford University Press, 2000

Longhi, C, “Networks, Collective Learning and Technology Development in Innovative High Technology Regions: The Case of Sophia-Antipolis,” Regional Studies, Vol. 33, No. 4, pp. 333-342, 1999

Ministry of enterprise, opportunity and innovation, “Guidelines for developing a biotechnology cluster innovation plan,” Ontario, Canada, 2003

Moulaert and Sekia, “Territorial Innovation Models: A Critical Survey,” Regional Studies, Vol. 37.3, pp. 289-302, 2003

National Governors Association, “A Governor’s Guide to Cluster-Based Economic Development,” (www.nga.org), 2003

National Governor Association and Council of Competitiveness, Cluster-Based Strategy for Growing State Economies, 2007

Nauwelaers, “Innovative Hot Spots in Europe: Polices to promote trans-border clusters of creative activity,” Background Paper on Cluster Polices, European Commission, 2003

Nesta, Patel, and Arundel, “Innovative Hot Spots in Europe: Polices to promote trans-border clusters of creative activity,” Background Paper on Methods for Cluster Analysis, European Commission, 2003

OECD, Boosting Innovation: The Cluster Approach, OECD, 1999

OECD, Innovative Clusters: Drivers of National Innovation Systems, OECD, 2001

Park Young-Gyu, “Guro Industrial Complex Is Rising Again,” Korea Economic Trends, Samsung Economic Research Institute, 2007

Piore, M. J. and C. F. Sabel, “The Second Industrial Divide: Possibilities for Prosperity,” Basic Books, 1984

Porter, “The Competitive Advantage of Nations,” The Free Press, 1990

Porter, “Clusters and the New Economics of Competition,” Harvard Business Review Nov.-Dec., pp. 77-90, 1998

Tai-Shan Hu, Chien-Yuan Lin, Su-Li Chang, “Technology-based regional development strategies and the emergence of technological communities: a case study of HSIP, Taiwan,” Technovation 25, pp. 267-380, 2005

UK Department of Trade and Industry, A Practical Guide for Developing Clusters, 2004

# Chapter 2. Technology Collaboration

Rern-jier Sheu[1]

Stepping into the era of globalization, R&D activities often have key effects on industrial competitiveness. The extensive R&D activities in business include the modification in product and/or process, the application of new materials, the new design on package, and business model innovation. Major R&D activities have turned out to be more and more costly. In such hard situation, collaboration in research activities is a better way for firms who cannot afford the required budget alone.

SMEs are often facing many kinds of difficulties when they conduct in technology activities such as applying an existing technology to a new application, applying a new technology or business model to an existing application, improving an existing technology or product upon various aspects. Each activity consumes the limited, insufficient resources owned by SMEs. Therefore, how to leverage outside resources efficiently and turn that activity into business value has become a critical issue for SMEs. Among APEC members, many successful stories can be found and revised into learning materials.

Technology collaboration can help forward-thinking businesses and organizations accelerate the pace of innovation and bring competitive advantage in the marketplace. How to establish a solid mechanism to promote technology collaborations among SMEs, academia, and public research institutes is an important topic for those developing economies of APEC.

In this training course, ITRI's experience and some policies applied by Chinese-Taipei will be backbones of the content. In essence, this course will focus on helping SMEs overcome the barriers to technology development and adoption from a policy maker's point of view.

## 1. Introduction

### 1.1. Preface

The manufacturing paradigm is evolving from a large number of discrete, monolithic organizations to decentralized suppliers linked in supply chains. To optimize performance, supply chains operate in a highly coordinated manner through virtual manufacturing networks. The fact is: SMEs are hard pressed to keep pace with this emerging environment. Developing a brand new idea, concept or new technology seems to be a popular solution to SMEs' difficulties nowadays.

Stepping into the era of globalization, R&D activities often have key effects on industrial competitiveness. The extensive R&D activities in business include the modification in product and/or process, the application of new materials, the new design on package, and business model innovation. Major R&D activities have turned out to be more and more costly. In such hard situation, collaboration in research activities is a better way for firms who cannot afford the required budget alone.

The requirement for SMEs to collaborate, as a means to supplementing and complementing limited internal resources, has dominated much of the academic and policy debate on regional

[1] Senior Administrator of ITRI College, ITRI (Industrial Technology Research Institute), Chinese

development and SMEs innovation throughout the late 1980s and 1990s. However, relatively little empirical work has sought to look further than simple frequency enumeration- noting that the most innovative and better performing firms are generally more likely to have links with external organizations. While the general findings point to innovators making greater use of external linkages, of certain types and in particular directions (notably the preponderance of vertical value chain linkages), the results are less emphatic than might have been anticipated. This leads to consideration of the factors contributing to and impeding joint innovation and the firms' perceptions of the impact of innovation. From this, it appears that much of the observed difference between innovators and non-innovators lies in less objective measures.

Furthermore, the process of SMEs' Technology Collaboration is very sophisticated. Inter-personal dynamics, attitude and expectations in facilitating successful collaboration are critical for SMEs' Technology Collaboration.

Limited by critical mass, SMEs always need to cooperate with other department to perform technological innovation projects. In recent three years, the ratio of manufacturing SMEs who had innovation cooperation projects in some typical countries like Austria, France, Netherlands, and the average of European Union was about 12%. Such ratio of developing countries and economies of APEC was lower.

Significant economic benefits can be generated by appropriate technology collaboration. But in most cases of APEC members, SMEs do not have enough capability to conduct successful innovation alone. It is critical for developing economies of APEC members to learn how to establish an effective mechanism that encouraging technology collaboration from a government's point of view.

Technology collaboration can help forward-thinking businesses and organizations accelerate the pace of innovation and bring competitive advantage in the marketplace. How to establish a solid mechanism to promote technology collaborations among SMEs, academia, and public research institutes (PRI) is an important topic for those developing economies of APEC.

Commercialization seems to be always an issue in technology development and innovation. With more than 34 years of industrial service experiences, Industrial Technology Research Institute (ITRI) has long been a policy think tank for industrial development and faithful partners for industries in Chinese-Taipei's economic development history. ITRI is well experienced in not only industrial services, but also in collaboration R&D with universities and SMEs. For SMEs who have developed an innovative technology, ITRI can help them locate organizations interested in using it. ITRI can assist SMEs in further development of their technology or process and point them towards collaboration possibilities that may lead to licensing, commercial agreements or technical assistance.

---

Taipei

In this training course, ITRI's experience and some policies applied by Chinese-Taipei will be backbones of the content. In essence, this course will focus on helping SMEs overcome the barriers to technology development and adoption from a policy maker's point of view.

**Why this program?**

In general, most high-level research personnel (with a doctor degree) are in universities, indicating that universities own plentiful research capacity that can be exploited by industry to pursue innovation and technological development. On the other hand, SMEs lack R&D resource and capability. Theoretically, this can be improved by collaboration with universities. However, exactly due to SMEs' lack of resource and difficulty to access the information, SMEs are relatively unable to build the cooperative relationship with the academia. To promote collaboration between SMEs and academia, the government should draw up a series of policies to establish a favorable environment and create intermediary mechanisms for industry-university collaboration.

**Expected benefits**

Trainees will learn practical knowledge to help them:

- Have a clear picture for related policy-making
- Build stronger relationships among SMEs, government, academia, research institutes
- Obtain a better skill in technology collaboration projects management
- Help government to identify more suitable resources allocation
- Establish effective mechanism for technology collaboration
- Increase the success rate of technology collaboration
- Build up an international networking for technology collaboration

Such benefits may not be seen in a short period of time. But the important issue is how trainees do practice what they have learned during the course. The change of mindset takes great efforts to achieve. Once a policy maker changes his/her mindset, with proper techniques, the positive policy effect will appear sooner or latter. Thus the value of the course can be measured.

**A check list of your needs**

Please fill in questions:

1. The most important industry of your country's SMEs is:

☐ Service industry ☐ Manufacturing industry ☐ Agriculture & fishing

2. Is Technology Collaboration an important issue in your country?

☐ Yes ☐ No

3. Did you ever involve in the management/policy making of Technology Collaboration for SMEs?

☐ Yes ☐ No

4. Do you have some successful Technology Collaboration examples in your country?

☐ None ☐ Very few ☐ Some ☐ Quite many

5. How many research organizations do you have in your country to assist SMEs' R&D activities?

☐ None ☐ Only few ☐ Less than 10 ☐ More than 10

6. How many universities/colleges do you have to serve SMEs' R&D activities?

☐ None ☐ Only few ☐ Less than 10 ☐ More than 10

7. What is the main objective of SMEs' Technology Collaboration in your country?

☐ To expand the global market

☐ To upgrade the nation's industrial technology level

☐ Both

☐ None of the above, it is ……

8. Your evaluation on the performance of SMEs' Technology Collaboration activities in your country is

☐ Need much to be improved

☐ Need to be improved

☐ Fair

☐ Good to excellent

9. Key issues of the future development of SMEs' Technology Collaboration inyour country:

(Please identifying three issues.)

## 1.2. Some models of technology collaboration

An SME-Academia-Public Research Institute Technology Collaboration Project could be in form of many types. By establishing an analytical matrix, one can easily develop many kinds of models. It appears that the Technology Collaboration by nature is a sophisticated process and needs lots of efforts inside.

**Table 1 Model Matrix of Technology Collaboration**

| **Party involved**<br>**Comparative Item** | **SME** | **Academia/PRI** | **Government** |
|---|---|---|---|
| **Project size**<br>Small<br>Medium<br>Large | | | |
| **Project period**<br>Short-term<br>Mid-term<br>Long-term | | | |
| **Project level**<br>International<br>National<br>State/Province<br>Local/community | | | |
| **Leadership**<br>Mono<br>Co-own | | | |
| **IPR ownership**<br>Monopolistic<br>Co-own<br>Equally sharing<br>Unequally sharing | | | |
| **Number of each party**<br>Single<br>Multiple<br>Alliance | | | |
| **Team**<br>Formal<br>Informal<br>On-site<br>Virtual | | | |
| **Technology source**<br>In-house<br>Introducing overseas | | | |
| **Government support**<br>With<br>Without | | | |
| **Objectives**<br>Mass production<br>Pilot run<br>Prototype<br>Proof<br>Test | | | |

## 1.3. A brief introduction of the SBIR Program in the USA

**Background**

- The risk and expense of conducting serious R&D efforts are often beyond the means of many SMEs.
- Targets the entrepreneurial sector where most innovation and innovators thrive.
- The Federal Government reserve a specific percentage of federal R&D funds for SMEs.
- SBIR protects the SME and enables it to compete on the same level as larger businesses.
- Funds the critical startup and development stages
- Encourages the commercialization of the technology, product, or service
- Enact in 1982 as part of the Small Business Innovation Development Act
- A highly competitive program that encourages SMEs to explore their technological potential and provides the incentive to profit from its commercialization

**Four major goals designed by the US Congress**

- Stimulate technological innovation
- Use small business to meet federal R&D needs
- Foster and encourage participation by minorities and disadvantaged persons in technological innovation
- Increase private-sector commercialization innovations derived from federal R&D

**Eligibility**

- Organized for－profit U.S. business
- At least 51% U.S.－owned and independently operated
- Small Business located in the U.S.
- Project instructor’s primary employment with small business during project
- Five hundred or fewer employees
- Eligibility is determined at time of award
- No appendices allowed in Phase I
- The project instructor is not required to have a Ph.D. but is required to have expertise to oversee project scientifically and technically
- Applications may be submitted to different agencies for similar work

- Awards may not be accepted from different agencies for duplicative projects

**The system**

Annually, eleven federal departments and agencies are required by SBIR to reserve a portion of their R&D funds for award to SMEs. These agencies designate R&D topics and accept proposals. The approval of awards is based on SMEs' qualification, degree of innovation, technical merit, and future market potential.

**Three－phase program**

- Phase I: Startup phase. Awards of up to $100,000 for approximately 6 months support exploration of the technical merit or feasibility of an idea or technology.
- Phase II awards of up to $750,000, for as many as 2 years, expand Phase I results. During this time, the R&D work is performed and the developer evaluates commercialization potential. Only Phase I award winners are considered for Phase II.
- Phase III: Period during which Phase II innovation moves from the laboratory into the marketplace. No SBIR funds support this phase. The SME must find funding in the private sector or other non-SBIR federal agency funding.

**Table 2 SBIR Awarded 2004**

| | Ⅰ | Ⅱ | **Total** |
|---|---|---|---|
| **Number of awards** | 4,304 | 2,044 | 6,348 |
| **Dollars** | 497 million | 1,517 million | 2,015 million |
| **Average Dollar Size** | US$115,000 | US$742,000 | US$317,000 |

*(Source: SBIR, the USA)*

## 2. The Nature of Technology Collaboration

### 2.1. From Technology Innovation to Value Creation

Innovation and technology excellence do not bring in value before they have fulfilled business realities. A common myth among many researchers and engineers is that they tend to take interesting and challenging R&D topics but ignoring the importance of economic value.

For one who get involved in R&D activities, one should put oneself in the customer's shoes：

- Understand what drives the customer's business
- Be an expert in the customer's microhabitat
- Know the customer's customers
- Ask what keeps the customer up at night
- Ask how much the customer would pay for a solution

## 2.2. Win-win game vs. zero-sum game

A win-win game is a game designed in a way that all participants can profit from it in one way or the other. It emphasizes the importance of cooperation, sharing, care and over-all group success in contrast to domination, egotistic behavior and single party's gain. All players are treated as equally important and valuable. As the same, the purpose of any Technology Collaboration is to obtain benefit by each party. Team members are from different parties with different backgrounds and working patterns, thorough communication and negotiation before embarkation and building mutual trust during the process is the key to achieve a win-win game.

The result of the Technology Collaboration is "either profit or loss sharing." Due to its complicated nature, a proper design of the game rule and a healthy mindset are essential.

## 2.3. Evolving roles of R&D in different phases

In macro aspect, the economic development of a nation is a process of evolution. Take Chinese Taipei as an example, its development can be divided into six phases since 1953 after the Korean War:

- Import-Substitution / Labor-intensive Industry : 1953-1962
- Export-Expansion / Light Industry : 1963-1972
- Import-Substitution / Heavy Industry : 1973-1980
- Industry Upgrade / Strategy Industry : 1981-1990
- Hi-Tech Industry : 1991-2000
- Creative R&D Industry : after 2001

In a micro aspect, the role of R&D is also evolving in different phases. A completed process of R&D is a combination of creativity, innovation, and commercialization.

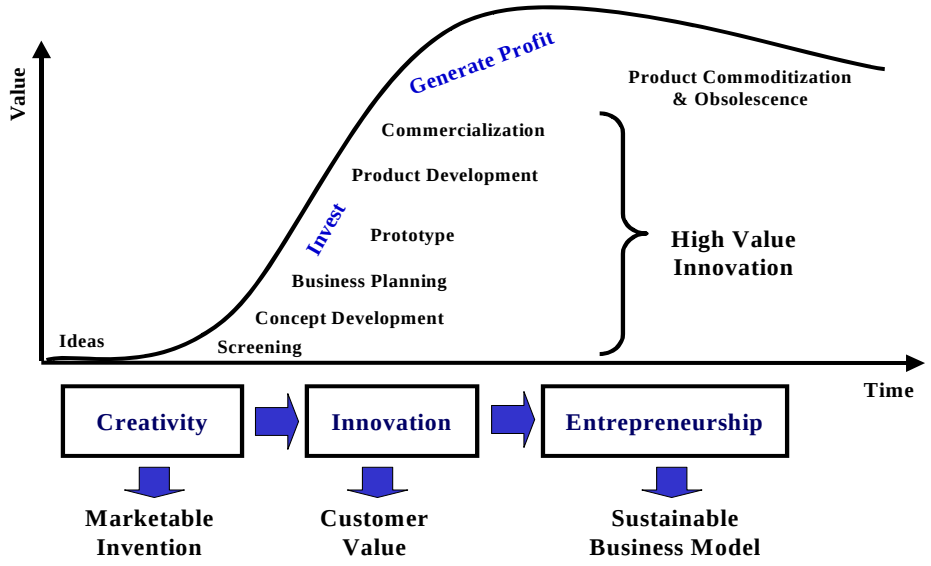



**Fig 1 Value Creation**

**Tell A from B**

- Creativity: Something clever
- Invention: Something novel reduced to practice
- Innovation: Creation and delivery of sustainable new customer value into the marketplace

In the phase of creativity, ideas are the most needed and marketable inventions are the most precious. The second phase is innovation that shall be focus on customer value instead of technological excellence. The last one is entrepreneurship or called commoditization. Economic value of R&D reveals after this phase is reached. The strategic thinking here is how to obtain a sustainable business model.

## 2.4. Strength and weakness of each party

A solid team of a typical Technology Collaboration Project should consist of the SME, the academia, and the government that create synergy through the contribution of their own uniqueness or competitive advantages.

**Table 3 A Brief Comparison of the Three Parties Involved in Technology Collaboration Projects**

| | Strength | Weakness |
|---|---|---|
| **SMEs** | Commercialization ability<br>Efficiency | Capital input<br>Research ability |
| **Academia/ Public Research** | • Human capital, equipment, facilities for R&D | • Market sense/Information<br>• Cost control (time and |

| | | |
|---|---|---|
| **Institute** | • Overseas networking | money) |
| **Government** | Funding<br>Policy guidance/Authorities | Slow management flows<br>Rigidity |

## 2.5. Roles among stakeholders

Tracking back to the industry environment in Korea and Chinese Taipei, from traditional manufacturing export in the 60s, to the technology manufacturing export in the 80s, till the organization and operation of Business Incubators, academia and research institutes have been playing an important role along the way. Those aggregate powers did their best endeavor to start the development for technology industries about thirty years ago. Now research power from academia shows more evidence in pulling the research innovation to the extreme. It is expected to seeing a great success in upgrading the industry by integrating the strengths of all resources from industry, government, academia, and research institutes. The models applied by Korea and Chinese Taipei may be modified into some appropriate models for those SMEs in developing countries and economies of APEC.

Research organizations, academia, and industry are the main elements in a national innovation system. Academia is mainly concerned with basic research, which discovering and disposing the rules and principles in academic disciplines. Research organizations undertake applied research, investigating the discoveries of academia and ascertaining the feasibility of product application. SMEs take the use of the R&D results of the previous two bodies to undertake commercialization activities.

However, it is the interaction among different elements in models of industrial innovation that spurs R&D efficiency. In order to accelerate knowledge creation in universities and research organizations and its more rapid application in industry, it is necessary to enhance the interaction among the three key players. Also crucial is strengthening the joint participation of these three in the process of knowledge creation, and product development at each stage, in order to smooth the whole process.

The industrial innovation activities of research organizations include defining targets based on demand for specific technologies and then implementing the results in industry through R&D and commercialization. Research organizations integrate the efforts of academia, industry, and government as well as foreign organizations in order to form mechanisms of industrial innovation and a smooth operating system.

- **SMEs**
  - Demander of Technology Collaboration activities
  - Be responsible to dig out market needs and turn them into R&D topics
  - Product/service information providers

- Cost controllers
- Major investor of Technology Collaboration
- Receiver of R&D results

■ **Academia/PRI**

- To offer facilities, experts, technology and sometimes even business incubating system
- To integrating multiple resources to lead and to support SMEs in a geographical area
- To stimulate business activities and expand SMEs' market
- Building international networking for Technology Collaboration

■ **Government**

- To create ideal environment for Technology Collaboration activities by means of proper policy making and promoting
- Funding provider (Not all the time)

■ **ITRI Case**

Industrial Technology Research Institute (ITRI) is the major R&D organization to serve SMEs in Chinese Taipei. It is engaging in innovation activities, implementing R&D results and the founding of new industries or aiding in the upgrade of existing ones. The results of the innovation process include products, processes, and services, while the extent of innovation runs from radical innovation on one end of the continuum to systems innovation on the other.

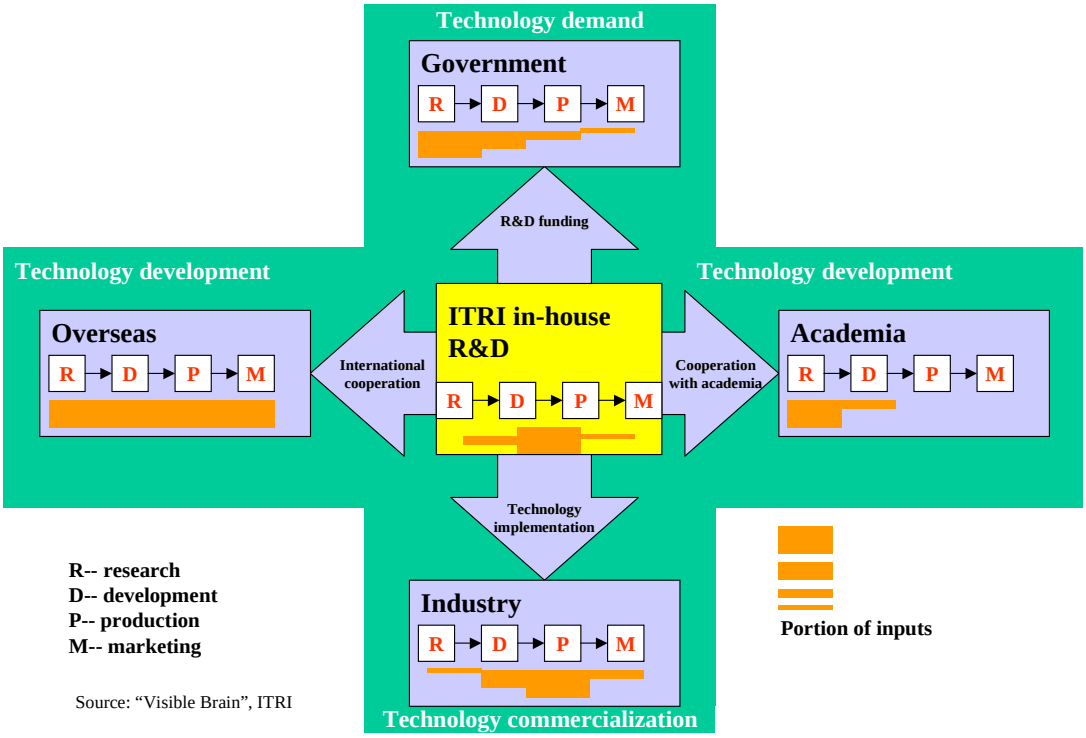



**Fig 2 ITRI's Model to Format Industrial Innovation**

**Relationship between research organizations and government - Technology demand**

Government subsidized or contracted research organizations to undertake R&D activities. In the selection of technologies for development funding, the principle is to follow industrial demand. The selection process first is to analyze the present status of domestic industrial development in order to choose a target industry. Then it selects the key technologies of this industry and analyzes their influence on the development of the industry and related industries. The government relies on R&D funding to effectively link government aims with research organization performance.

**Relationship between research organizations, academia and foreign organizations - Technology development**

After selecting technology for development, research organizations will plan a development process to benefit industry as it undertakes the production activities involved in commercialization. Research organizations propose project execution plans according to the technology to be developed. These plans are comprehensive, covering the content of the technology, manpower, funding, and progress. At the same time, it is necessary to provide outlets for the technology when it is properly developed, as well as ways to transfer the technology to industry. The project leader will divide the tasks specified by the plan among work units. Appropriate personnel at these units carry out the actual R&D activities, which

involve the following tasks and operations: in-house R&D, contract research, cooperation with academia, and introducing technology from abroad through cooperation with foreign institutes. Interrelationships among research organizations, academia, and foreign bodies are thus established.

**Relationship between research organizations and industrial technology - Commercialization**

Technology commercialization indicates that the transfer of research organization technology development results into commercial applications. The transfer process involves applying new technologies in ways that increase economic benefit or production capacity. It also involves transferring relevant specialized knowledge or technology from research organizations to industry, where commercialization takes place. Research organization disseminates information through various means, including the media, result presentation conference, technology symposiums, and visit to enterprises. They also transfer needed technology to the enterprises themselves according to their capacity to accept the technology. Approaches to technology transfer are direct transfer, technology licensing, or help with personnel training. The specificity of the demands of the industry is taken into account and modifications made or new technologies are developed. In some cases, technology and talent will be spun off to establish new ventures. Research organizations establish tight relationships between themselves and industry by means of information dissemination, technology licensing, the spin-off new companies.

**The evolution of ITRI's mechanisms of industrial innovation**

ITRI was established thirty-four years ago with a not-for-profit legal entity so as to have more flexibility in responding to the dynamic industrial development environment. It has made appropriate and timely adjustments to its developmental emphases and strategies in order to achieve accelerating improvement of industrial technology, help in establishing newly emergent technology industries and upgrade traditional ones, especially to help SMEs to enhance their global competitiveness. For ITRI, both the R&D activities themselves and their implementation in industry are equally important. These two facets interact in the formation of effective mechanisms for industrial innovation and a smooth innovation system. ITRI's industrial innovation mechanisms have three stages: technology demand, technology development, and technology commercialization.

- Technology commercialization (three stages)
  - Technology oriented (before 1990s)
  - Industrial oriented (in early 1990s)
  - Innovation oriented (since late 1990s)
- Technology development

- ITRI-based R&D
- Technology introduction from overseas
- Leveraging external resources
  - ─Industry cooperation
  - ─Academic cooperation
  - ─International cooperation

■ Technology commercialization

- Information dissemination
- Technology transfer
- Patent licensing
- Spin-off of new ventures
- Industrial contract development
- OpenLab (Joint Research/Collaboration Program, Business Incubation)

**Characteristics of ITRI's industrial innovation mechanism**

- In order to spur industrial innovation, ITRI examines the domestic industrial development situation, and selects interconnected methods of industrial innovation in a timely fashion. The model can be called as "Adaptable Industrial Innovation Model"
- ITRI integrates government, academic, industry, and foreign resources to make the most of industrial innovation. Thus the ITRI model encourages the integration of the national innovation system.
- In the process of industrial innovation, ITRI takes a central position in technology development and commercialization. It has connections with all resources for national integrated innovation. The ITRI model therefore also manages national innovation resources.
- ITRI's role in the national innovation system is that of a bridge between academia and industry. Each sphere—academia, industry, government, and other research organizations—can take advantage of the various mechanisms of industrial innovation through ITRI. The present model thus places ITRI as the strategic operator of the entire national innovation system.

## 3. Turning Technology into Business Value

**Some conceptual figures from SRI International**

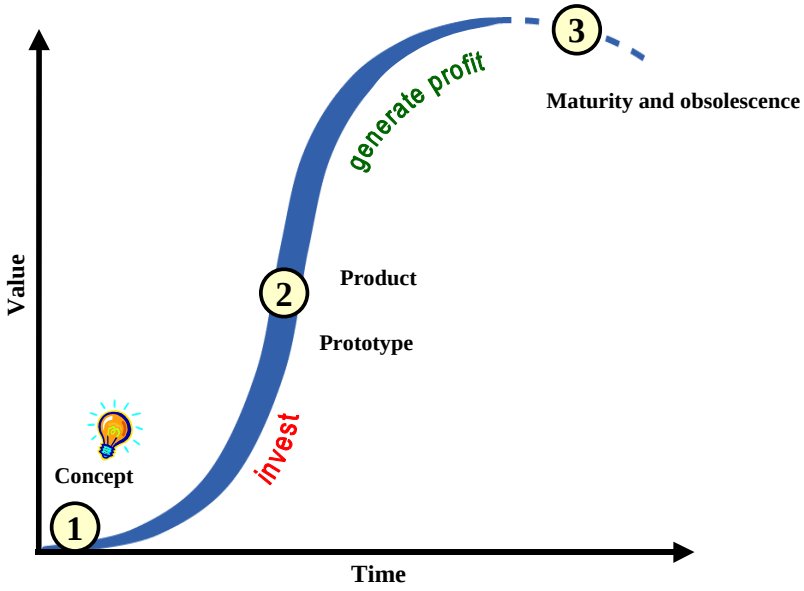



**Fig 3 Product Life Cycle**

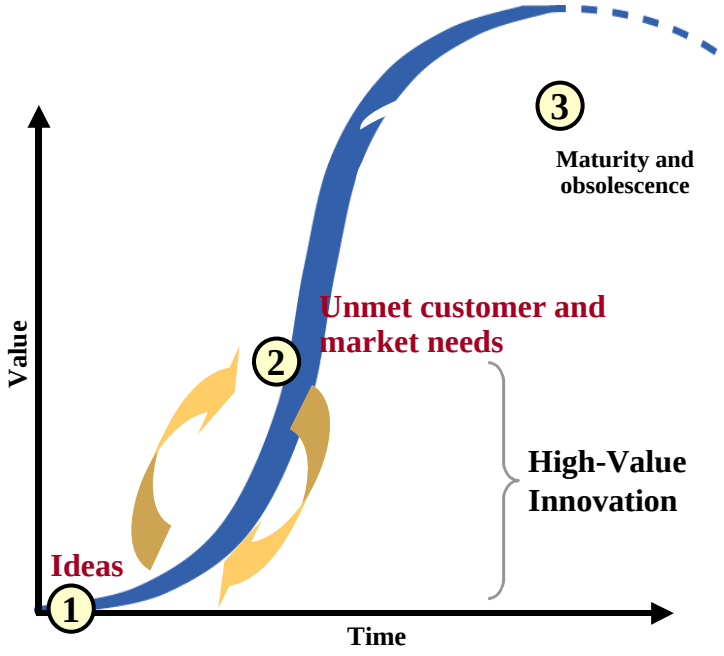



**Fig 4 The Best Model (Market pull, technology-enabled)**

### 3.1. Ways to cope with the “the Valley of Death”

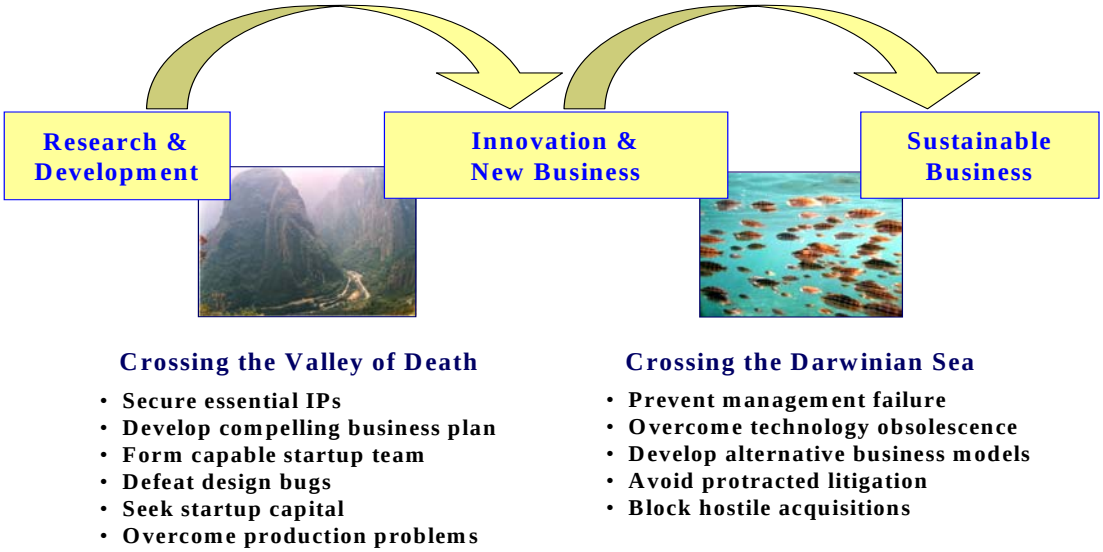



**Fig 5 Two Gaps for Sustainable R&D**

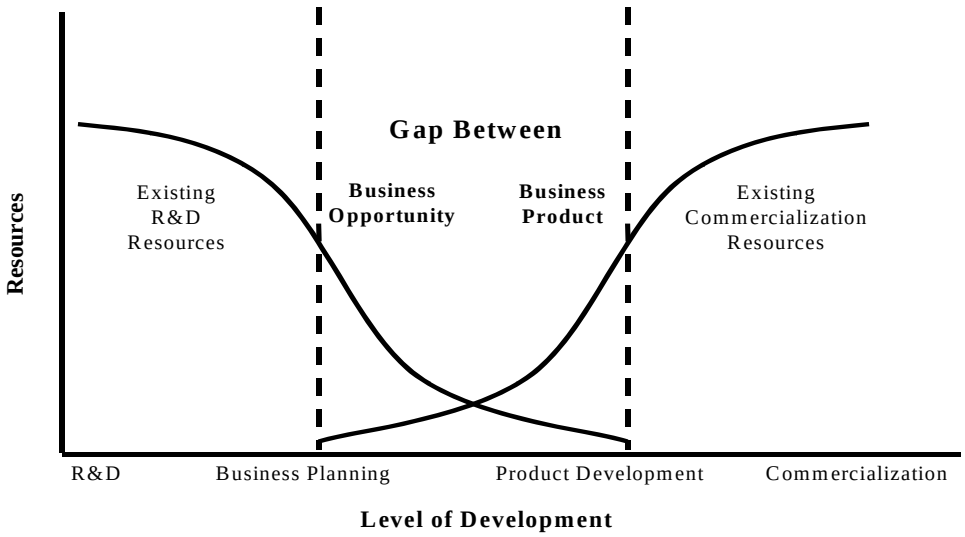



**Fig 6 Valley of Death**

- It takes two jumps from R&D activities to obtain a sustainable business.
- Many new ventures never cross over the Valley of Death.
  - 18 to 19 out of every 20 new products fail within a year
  - One out of every 5 to 10 ventures succeeds

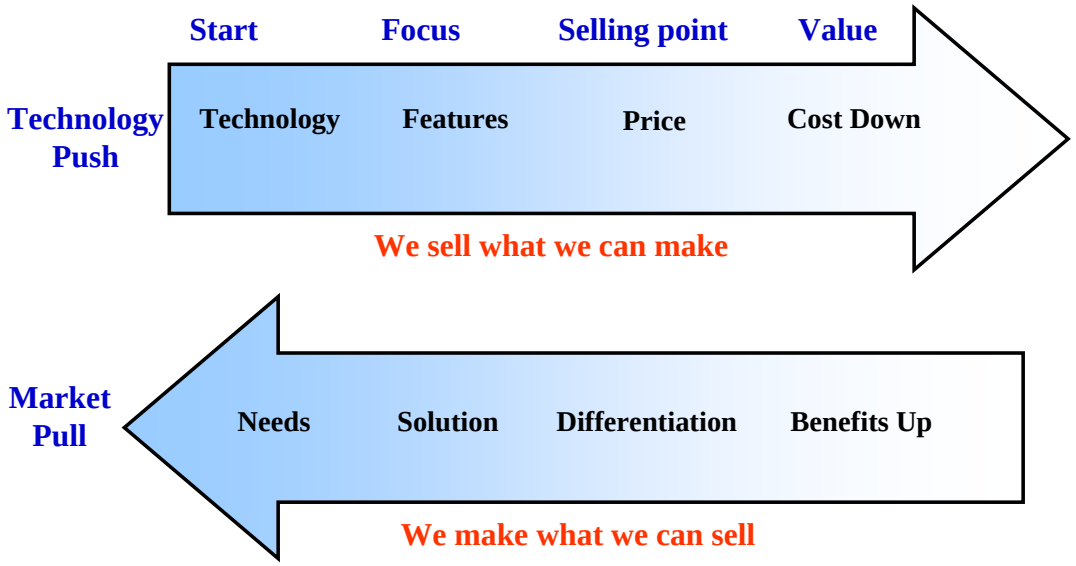



**Fig 7 Technology Push vs. Market Pull**

### 3.1.1. How to Choose the Right R&D Topic

Many of the new technologies currently being developed are in fact best suited to SMEs. Unlike their larger counterparts, SMEs can respond more effectively to the short-time-to-market, rapid innovation, flexibility and other characteristics of these new technologies.

Conducting R&D activities but without economic outcomes is a waste of a nation's valuable resources. The choice of a good topic accounts for more than fifty percent of the contribution to a successful R&D activity. One can never be too careful to choosing an R&D topic. Considerations for picking up R&D topics may include:

- Emphasize the further growth of both production volume and production value
- Appropriate technologies instead of high/new technologies
- Higher "Chain-effect" or "Derivable-effect" for the industry
- With development niche along the value chain of economic activities
- Budget/supporting system
- Balance between benefits and risks

- Apply “Red Ocean Strategy” and “Long Tail Theory”

■ **Red Ocean strategy**

- Compete in existing market space
- Beat the competition
- Exploit existing demand
- Align the whole system of a company’s activities with its strategic choice of differentiation or low cost

■ **Blue Ocean Strategy**

- Create uncontested market space
- Make the competition irrelevant
- Create and capture new demand
- Break the value/cost trade-off
- Align the whole system of a company’s activities in pursuit of differentiation and low cost

■ **The Long Tail Theory**

**$\Sigma$ of Long Tail $\geqq \Sigma$ of Body**

### 3.1.2. Team up

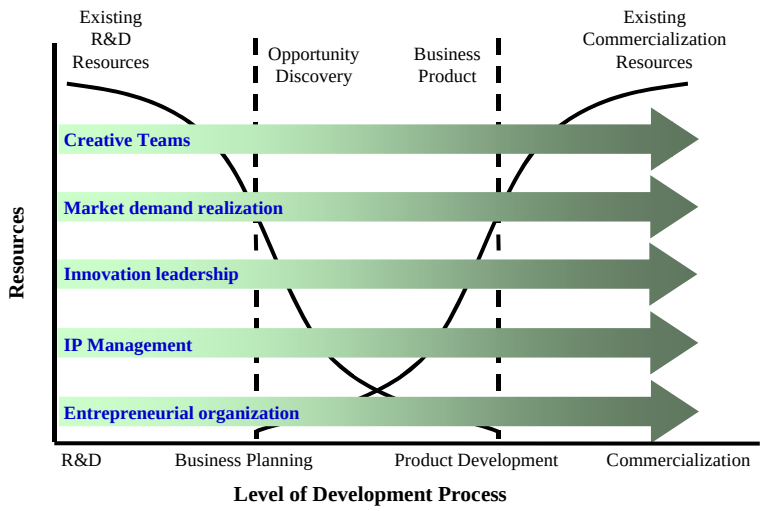



**Fig 8 The Level of Development Process**

**Organizational capacities for crossing the Valley of Death**

- Analyze the trend of industry and market; set the technology position and market strategy.
- Command the core technology of an organization; forecast the development of the technology.
- Plan R&D strategies with proper methods and paths for new technology and product development.
- Manage the intellectual property; create R&D value.
- Propose a feasible R&D project plan based on R&D strategies for new technology and product development.
- Analyze, compare, and evaluate proposed R&D plans to determine their feasibilities or select the best option.
- Implement action plans of R&D projects; monitor, manage and control the R&D resources and activities; ensure R&D projects go smoothly.
- Determine the value of R&D output; market and promote R&D output for sale.
- Make budgets for R&D projects; manage R&D expenses and revise budgets as necessary; keep R&D project budgets under control.
- Organize and manage R&D human resources; motivate the creativities of R&D staff; create the environment for R&D innovation.
- Design the structure of an R&D organization; build the performance management system and HR development.
- Coordinate interdepartmental R&D functions and projects; manage the interface of cooperation and communication.

### 3.1.3. Funding

Funding is almost everything to a Technology Collaboration activity. Only by proper funding planing, the collaboration can move forward on schedule. The sources of R&D funding may come from government subsidy, bank loan, paid-in capital, or venture fund.

One of the most complicated problems associated with funding of collaborative R&D is the allocation of patent rights. This allocation should be a complex determination controlled by laws, executive orders, regulations, and policies of related government agencies.

**Measures of Financial Supporting for SMEs in Chinese Taipei**

- SME Credit Guarantee Fund
- Culture and Creative Industry Loans

- Digital Content Loan
- Loans for Buildup of R&D Environment
- SME Innovation Research Award
- Business Start-up Award

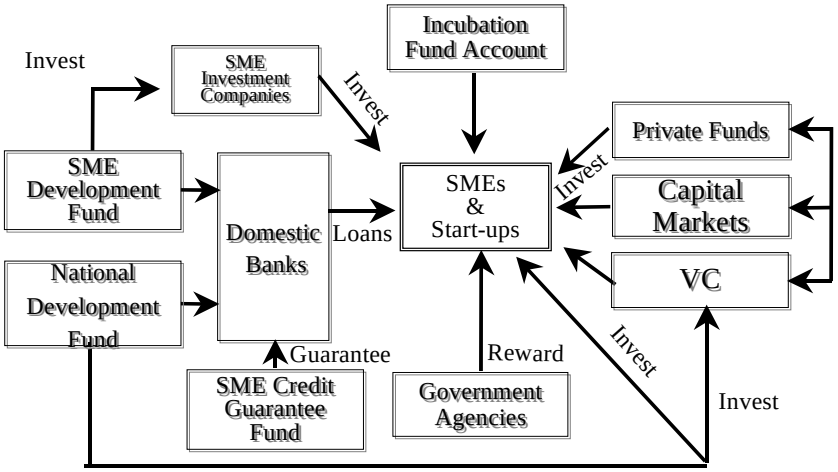



**Fig 9 Chinese Taipei's Model of Government Policy for SMEs' R&D Funding**

### 3.1.4. Leveraging outside resources

Obstacles of SMEs' long-term development may include

- Technology applications/Technologies for upgrading
- Capital
- Critical human resource for development
- Distribution channels
- e-applications (internet, computerized, ...)
- Market information
- Networking ability
- Core competencies
- Modern management
- Coping with threats from globalization trend

How to access to outside/overseas resources has turned out to be more and more critical for SMEs' development.

### 3.2. Suitable technology transfer models for SMEs in developing economies

An investigation by SRI International indicates that:

- 18 to 19 out of every 20 new products fail within a year
- One out of every 5 to 10 ventures succeeds
- 80% of new jobs come from new companies

Technology transfer models for SMEs in developing economies should possess several of the features below:

- Sufficient government support
- R&D alliance formed by local SMEs to receive technologies
- Start with easier tasks

## 4. How to Enhance SMEs' Technology Power: Government Policy and Firms' Practice

### 4.1. Identify a Country's Stand in Global Value Chain and Shift of the Smiling Curve

The purpose of SMEs' R&D activities is for products/services commercialization. The term "Value Chain" can just perfectly describe the whole process of R&D commercialization. Due to its shape, it has a nickname as "Smiling Curve." It is a full range of activities that firms and workers do to bring a product/service from its conception to its end use and beyond. It normally includes activities such as design, production, assembling, marketing, distribution and support to the end users. Activities comprising a value chain can be contained within a single firm or divided among different firms, and products/services can be contained within a single geographical location or spread over globally. The Value Chain has become much more prevalent and elaborate during the past two decades. In today's real world daily operations, firms and workers in widely separated locations affect one another more than they have in the past. Since firms and countries play their own roles based on competitive advantages, how to increase their competitiveness and occupy better positions of the value chain is often an important strategy in policy makers' minds. The Value Chain determines the roles of developed, developing, and underdeveloped countries in global stands of production. Players along the Value Chain normally include designer, material supplier, manufacturer, assembler, distributor, transporter, sales agent, buyer, and end consumer.

It is important for SMEs and policy makers to better understand how the Global Value Chain functions in specific case and to have some tools to help predict how they might change over time. Another issue they shall keep in mind is how to move toward both ends of the Value Chain through innovation and R&D efforts or by means of taking better positions in global

distribution and branding. The other is how to shit up to a higher curve and make an aggregate advancement of industries.

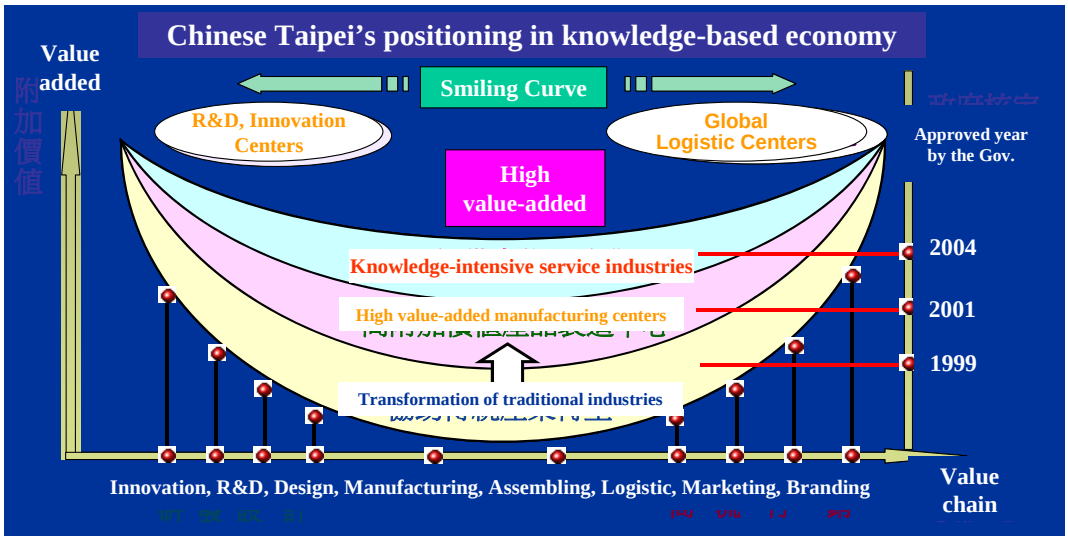



**Fig 10 Shift toward Both Ends of Smiling Curve**

## 4.2. R&D Input as an Investment: Mission Oriented

SMEs are often facing many kinds of difficulties when they conduct in technology activities such as applying an existing technology to a new application, applying a new technology or business model to an existing application, improving an existing technology or product upon various aspects. Each activity consumes the limited, insufficient resources owned by SMEs. Therefore, how to leverage outside resources efficiently and turn that activity into business value has become a critical issue for SMEs. Among APEC members, many successful stories can be found and revised into learning materials.

For most SMEs, R&D is a costly activity with a purpose for a better future. Any R&D input should be treated like an investment. It takes qualified R&D managers and competencies to perform qualified R&D activities.

- Mission-oriented R&D project
  - Must be concrete from the beginning
  - Will be reviewed at a predetermined time
  - A targeted approach and a centralized formation is suitable

- Achievements are mainly evaluated by whether they meet the targets and in terms of durability, reliability and economic sense.
- Outcome of the project is evaluated by whether it has created new products or industries.

■ R&D Project Evaluation

- Can be classified into four types:
  - Ex-ante evaluation—be conducted before a project starts and its purpose is to select a project or projects
  - Interim-evaluation—be conducted after a project has started to judge whether revising a project plan is necessary and whether a project is worthwhile to continue
  - Ex-post evaluation—conducted at the end of a project to evaluate final achievements, to analyze factors of success and failure and to reflect evaluation results on project formation and project management henceforth
  - Follow-up evaluation—be conducted five to ten years after a project finishes.

The evaluation aims at clarifying the outcome of R&D projects in both economic and technological terms.

**Table 4 Competencies of R&D Managers**

| **Knowledge** | **Skill** | **Attitude** |
|---|---|---|
| • Knowledge of industry<br>• Market information<br>• Technology forecast method<br>• Technology evaluation method<br>• Technology strategy<br>• Patent knowledge<br>• R&D human resource management<br>• R&D human resource development<br>• Organizational behavior<br>• Organization design<br>• Financial management<br>• Project management | • Focusing on customers<br>• Planning and execution<br>• Enabling results<br>• Enhancing performance<br>• Focusing on quality<br>• Managing Process<br>• Building partnership<br>• Resolving conflicts<br>• Expressing and communication<br>• Coaching and mentoring<br>• Innovation<br>• Enabling changes<br>• Logic reasoning and analysis<br>• Problem solving<br>• Strategic thinking<br>• Collecting information | • Achievement oriented<br>• Committed<br>• Relationship building<br>• Team player<br>• Team leadership<br>• Influential<br>• The awareness of organization<br>• Proactive<br>• Flexible<br>• Self confident |

**Table 5 Overall Ranking of R&D Management Competencies**

| Difficulty from high to low | | Importance from high to low | |
|---|---|---|---|
| Skill | Innovation | Attitude | Team player |
| Skill | Enabling change | Skill | Focusing on quality |
| Knowledge | Technology strategy | Skill | Innovation |
| Knowledge | Technology forecast method | Attitude | Team leadership |
| Skill | Strategic thinking | Attitude | Proactive |
| Skill | Enhancing performance | Skill | Problem solving |
| Attitude | Team leadership | Knowledge | Market information |
| Knowledge | Patent knowledge | Knowledge | Technology strategy |
| Knowledge | Technology evaluation method | Attitude | Self confident |
| Skill | Planning and execution | Skill | Planning and execution |

### 4.3. The Direction of SME's R&D in Developing Economies

R&D activities in developing countries by nature are different from those in developed economies. Seeking for high-technology development can easily turned to be a castle in Spain. Knowing a nation's ability and position is the lesson one for its R&D activities.

**Direction suggestion**

- Focus on international instead of domestic market/technology source
- Select items with potential development niche
- Intensive resource input on few topics
- Solid fundamental works
- Learning by doing with advanced counterparts
- Localization

**Planning for technology development**

**Step 1: Define core business**

**Table 6 Weighting Core Business Definition**

| The Best Description of Core Business | CB1 | CB2 | …. | CBn | Average | Weight (100%) |
|---|---|---|---|---|---|---|
| The most affordable product/service | | | | | | |
| More attractive product/service to customers than competitors' in the market | | | | | | |
| The most profitable/satisfied product/service | | | | | | |
| Best selling product/service | | | | | | |
| Product/service that create the most stable income | | | | | | |
| The most resource-consumption product/service | | | | | | |
| Product/service that creates most derivable effect | | | | | | |
| The fastest growing product/service | | | | | | |

**Table 7 Distribution and Identification of Core Business**

| **Product Line**<br>**The Best Description of Core Business** | **Weight (100%)** | **1** | **2** | **3** | **….** | **n** |
|---|---|---|---|---|---|---|
| The most affordable product/service | | | | | | |
| More attractive product/service to customers than competitors' in the market | | | | | | |
| The most profitable/satisfied product/service | | | | | | |
| Best selling product/service | | | | | | |
| Product/service that create the most stable income | | | | | | |
| The most resource-consumption product/service | | | | | | |
| Product/service that creates most derivable effect | | | | | | |
| The fastest growing product/service | | | | | | |

**Step 2: Inventorying technology abilities for core business**

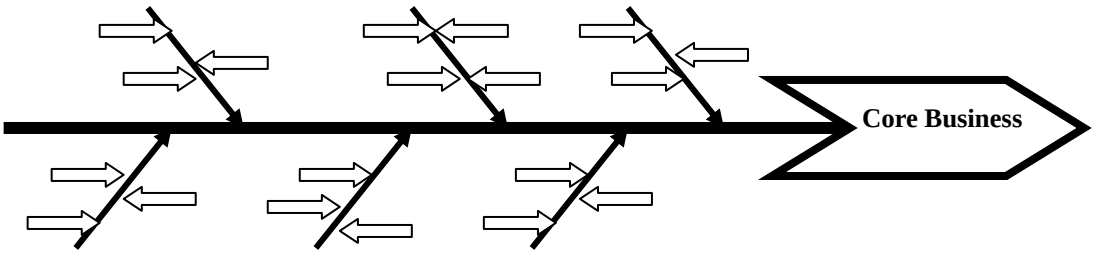



**Fig 11 A Fishbone Chart for Technology Inventorying**

**Table 8 A Comprehensive Technology Intensive**

| Tech Layer 1 | Tech Layer 2 | Tech Layer 3 | Technology owned | Competitors' Technology | Gap analysis | Possibility to enlarge the gap |
|---|---|---|---|---|---|---|
| Product 1 | 1.1 | 1.1.1 | | | | |
| | | 1.1.2 | | | | |
| | 1.2 | 1.2.1 | | | | |
| Product 2 | 2.1 | | | | | |
| | 2.2 | 2.2.1 | | | | |
| | | 2.2.2 | | | | |
| ….. | | | | | | |
| Product n | 3.1 | 3.1.1 | | | | |
| | | 3.1.2 | | | | |

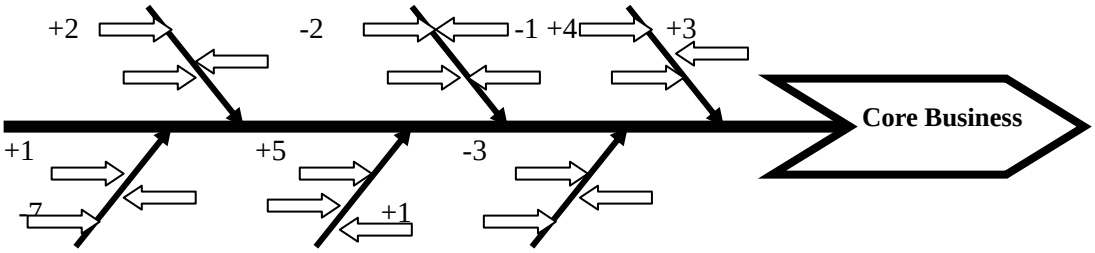



**Fig 12 A Comprehensive Fishbone Char of Technology Gap**

**Table 9 A Sample of Product/Technology Comparison**

| Competitor | "CP" vision | Main Access gateway | Main Consumer devices | Main Differentiator Versus A Co. | Impact on A Co.'s Connected Planet |
|---|---|---|---|---|---|
| Panasonic | Consumers to enjoy whatever they want, whenever they want it, wherever they are | DVD++<br>Digital TV | Full range:<br>Home<br>Mobile<br>Domestic Appliances | • Portable product portfolio<br>• 1st phase focused on Connected Home and iTV only, not BB connection<br>• SD technology<br>• Focus on creation content | • Hard for Philips to differentiate its CP message to consumer<br>• Panasonic can go to market with a broader portfolio |
| SONY | A world in which customers can enjoy content and share the content they create anytime and anywhere | PC<br>TV<br>Game<br>Mobile | Full range:<br>Home<br>Mobile | • Cover whole chain<br>• proprietary solutions<br>• Broader (very complete) portfolio including content creation devices<br>• Memory Stick technology | • Sony can go to market with a broader portfolio<br>• On its own: they built own standards: not attractive for partnering |
| SAMSUNG | Lead the digital convergence revolution worldwide, providing "Digital Freedom" to all. | STB<br>DVD? | Full range:<br>Home<br>Mobile<br>Domestic Appliances | • Building aggressively digital portfolio<br>• Aligning with Microsoft.<br>• Similar level of connectivity as Panasonic (home first)<br>• Memory Stick technology | • Philips seen as less innovative, flexible and open, as CE -> PC<br>• Hard to differentiate CP message<br>• Samsung can go to market with a broader portfolio |
| DELL | Delivering best customer experience, distribute content via home network to PCs, portable & CE prod | PC | Small range:<br>Home<br>Mobile | • Different (direct) business model<br>• Competes on price (~15% cost advantage)<br>• Not active on standardisation (Wait-and-see) | • Price pressure as Dell drive prices down fast |
| Microsoft | Software that helps people create & share digital memories & enjoy digital entertainment wherever they are | Media PC software<br>Game Console | Small range:<br>X-box | • Software stake in all product platforms, huge installed base<br>• Healthy financial condition<br>• Set standards<br>• Game console (X-Box) | • Can not avoid working with MS (to some extent)<br>• Microsoft will move aggressively into CE products |

1

**Step 3: Confirm important technologies**

- **Items to check**
  - How important are those technologies?
  - Are our technologies better than competitors'?
  - Possibility and time needed to be reinforced
  - Be effective for how long?
  - Be utilized by other product/business of our company?

**Step 4: Select core technologies and technologies to be reinforced most**

**Table 10 Core Technology Selection**

| | Core Business 1 | Core Business 2 | ……. | Core Business M | Core Technology/ Technology needs to be reinforced most |
|---|---|---|---|---|---|
| Important Tech 1 | | 3 | 1 | 3 | 7 = #2 |
| Important Tech 2 | 1 | | 1 | 2 | 4 = #4 |
| ….. | 3 | | 3 | 2 | 8 = #1 |
| ….. | | 2 | 2 | 1 | 5 = #3 |
| ….. | 2 | | 1 | | 3 = #5 |
| Important Tech n | | 1 | | 1 | 2 = #6 |

**Step 5: Technology development planning**

**Table 11 Core technology Development Plan**

| Item of Core Technology Index | 1.1.1 XXX | 1.1.2 YYY | 1.1.3 ZZZ |
|---|---|---|---|
| Adaptable product/service | | | |
| Present technology standard | | | |
| Competitors' technology standard | | | |
| Competitor's technology standard in three to five years | | | |
| Our technology standard in three to five years | | | |
| Gap | | | |
| Accountability | | | |
| Resource input | | | |

**Table 12 Plan for Technologies to be Reinforced**

| Item of Technology to be reinforced Index | 1.1.1<br>XXX | 1.1.2<br>YYY | 1.1.3<br>ZZZ |
|---|---|---|---|
| Adaptable product/service | | | |
| Present technology standard | | | |
| Competitors' technology standard | | | |
| Competitor's technology standard in three to five years | | | |
| Our technology standard in three to five years | | | |
| Channel to acquire | | | |
| Risk analysis | | | |
| Accountability | | | |
| Resource input | | | |

**Step 6: Establish a technology roadmap**

Technology Roadmap is a form of technology planning which can aid SMEs in a competitive environment. Technology planning is needed to identify and develop the technologies required of the SMEs. Once these technology enhancements or new technologies are identified they can be developed internally or collaboratively with external partners. For both approaches technology roadmap can be used as a tool to plan and coordinate the set of activities involved in the processes.

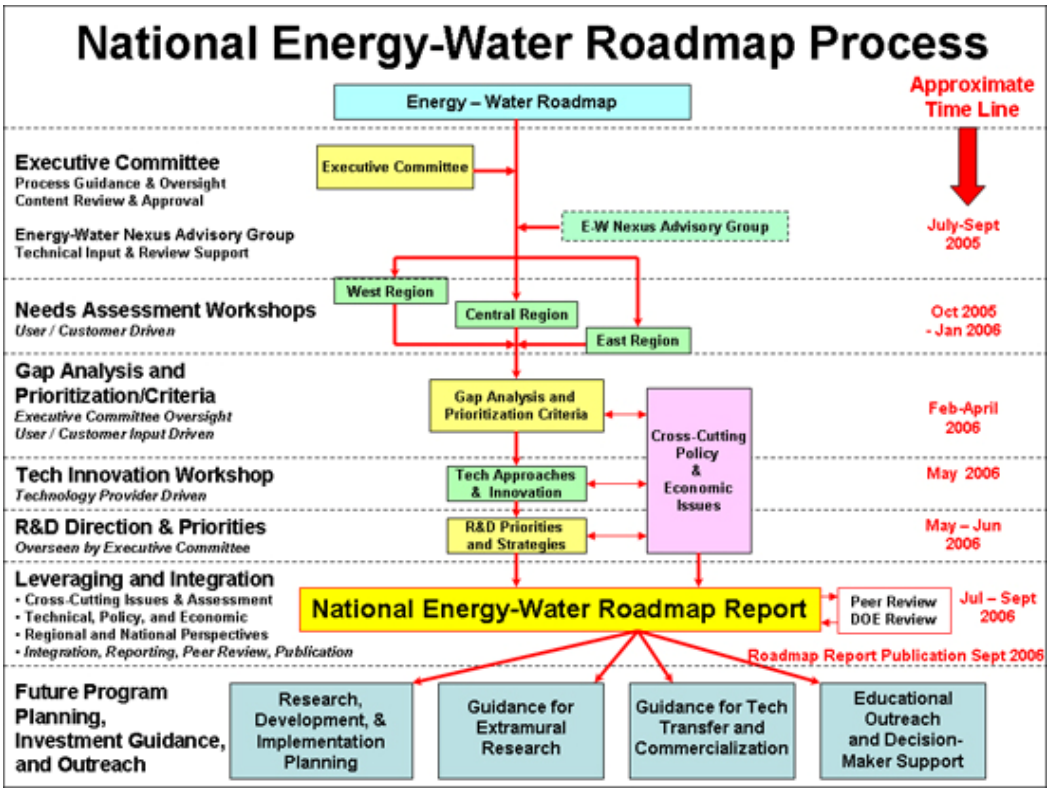



**Fig 13 Sample of Technology Roadmap (A)**

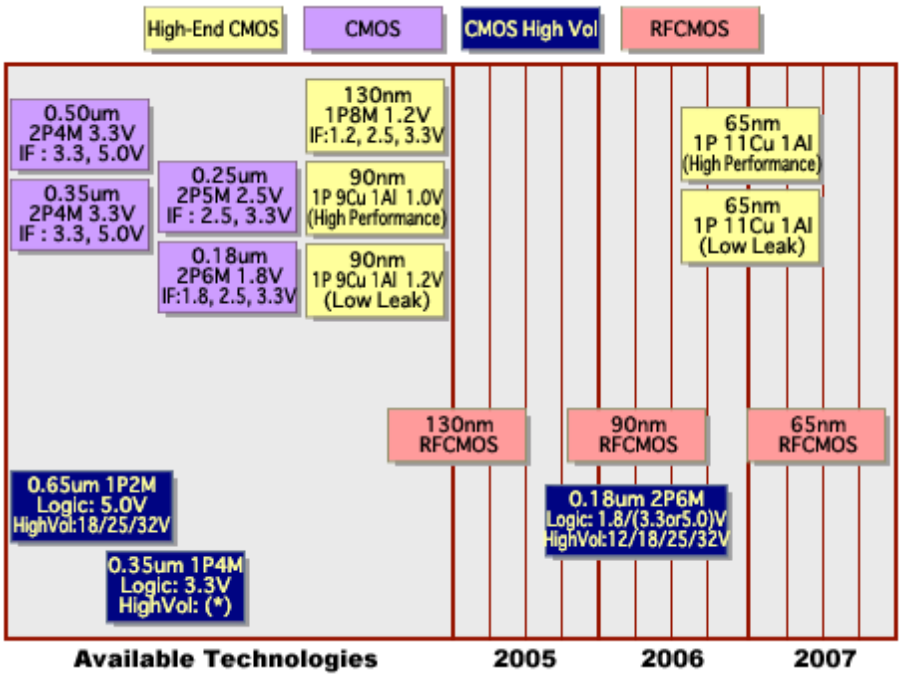



**Fig 14 Sample of Technology Roadmap (B)**

*(Source: Sandia National Loboratories; Fujitsu Co.)*

Technology-intensive SMEs often need to internationalize their activities, and especially sales, at a very early stage of their development because of the limited and global nature of the technological market niche which they have been set up to exploit. Many technology-based SMEs are engaged in a range of international networks and internationalization processes, including internationalization of markets, research collaboration, labor recruitment, ownership and facilities location. They reporting high levels of internationalization also differ significantly from which are more national-oriented, for example in terms of size, age, research intensity, university links, and innovation. Internationalization appears to be grounded or embedded in successful local networking and R&D collaboration.

Policy-making is always a complicated process. People who get involved are from different departments with different stands and propositions. The policy maker has to face the music and come up with a consensus through communications and integration.

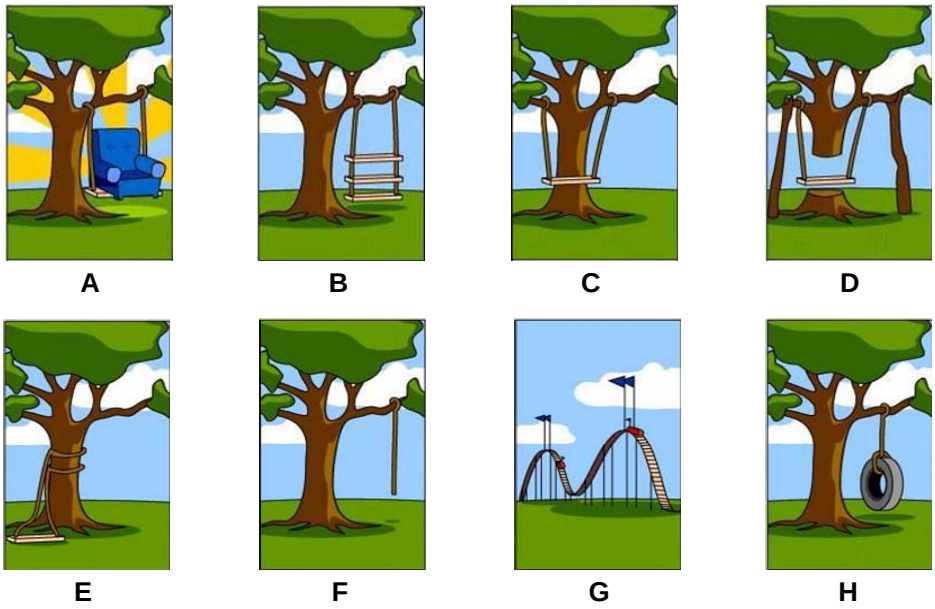



**Fig 15 Communication & Integration for Different Opinions in Policy Making**

"Technology push vs. Market pull" is a critical issue for R&D activities. Those who believe in "Technology push" tend to be with better science/technical backgrounds. They strongly believe that once a company can produce products/services with better performance, customers will buy the product/service. That is "good products are sold by themselves because of their high performance." A typical practice is the famous "Moore's Law" of IC industry. (Exponential Growth: 100% every 18 months)

On the other hand, people who believe in "Market Pull" tend to have better understanding of the market or sometimes less capable in technology development. They are demand-side believers. Which one is correct is subject to the situational changes.

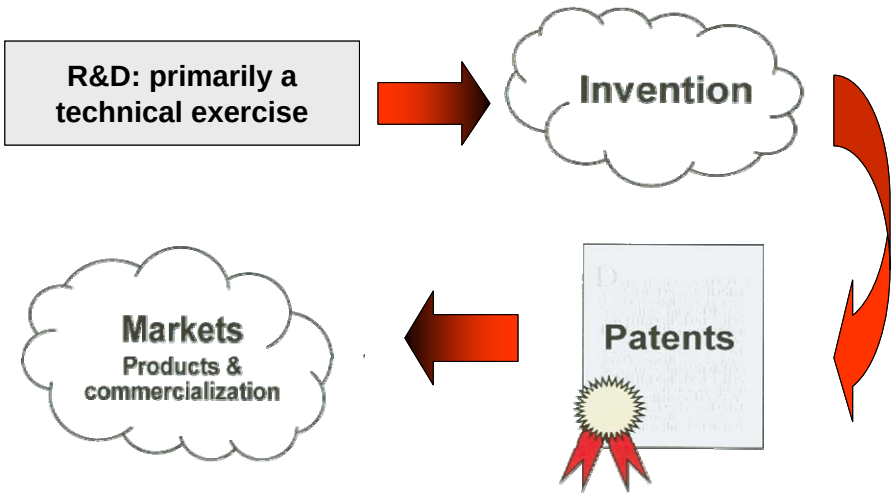



**Fig 16 Technology Push Model**

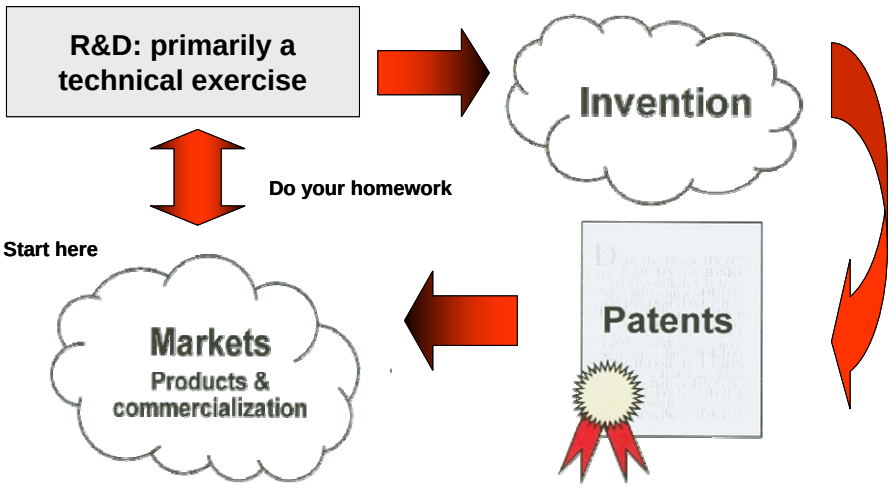



**Fig 17 Market Pull Model (From SRI International)**

The difference between Fig 13 and 14 is that: “Technology Pull believers” pay less attention to the linkage between R&D activities and markets. They just follow the pure technology development process and commercialize their R&D results into the market. On the other hand, those “Market Push believers” will notice the linkage between R&D activities and the market. They always start with the market surveys and do a lot of homework to make sure that their R&D activities are on the right track to meet the market needs.

## 4.4. R&D Alliances for SMEs

- A mutually beneficial formal relationship formed between two or more parties
- To pursue a set of agreed upon goals
- Remaining independent organizations
- To acquiring new knowledge is a goal by itself.
- All parties agree to combine their knowledge to create new technologies, products, or services
- For cost and risk reduction
- For the better use of aggregate resources
- Alliance among same or different industries
  - Vertical integration for raw materials, distribution channels
  - Horizontal integration to obtain stable business opportunities for each member
- Co-prosperity Sphere: each member is demander and supplier at the same time (heavily rely on information platforms)

## 4.5. Project Management for Each Party

- **SMEs**
  - Time to market
  - Stable and reliability of R&D results
  - Cost control
  - More sensitive to market/trend changes
  - Patent strategy
  - Business secret protection
  - Human resource development through the project
- **Academia/PRI**
  - R&D quality
  - Accumulation of R&D abilities
  - Paper/patent as objectives
  - Human resource turnover
- **Government**
  - Budget control (if any)
  - Expenditure status
  - Fairness
  - Project impact to the industry/economy

**Table 13 Top Threes of R&D Management Tasks**

| | | | |
|---|---|---|---|
| **Most difficult tasks** | **1. Analyze the trend of industry and market** | **2. Command the core technology** | **3. Plan R&D strategies for new technology and product development.** |
| **Most important tasks** | **1. Analyze the trend of industry and market** | **2. Command the core technology** | **3. Manage the intellectual property** |
| **Best performed tasks** | **1. Analyze, compare, and evaluate proposed R&D plans** | **2. Propose a feasible R&D project plan** | **3. Implement action plans of R&D projects** |
| **Worst performed tasks** | **1. Analyze the trend of industry and market** | **2. Manage the intellectual property** | **3. Design the structure of an R&D organization** |

**Industry-academia-PRI collaboration:**

**Chinese Taipei's experiences as the case study/present**

**A brief introduction of SMEs in Taiwan**

- Small & medium-sized new ventures of hi-tech industry have enjoyed prosperity during the past 10 years
- Arising sense of cooperation
- Moving toward service industry with technologies inside

**Table 14 Current Status of SMEs**

| | All enterprises | SMEs | % of SMEs |
|---|---|---|---|
| No. of enterprises | **1,253,694** | **1,226,095** | **97.80** |
| Total employments (thousand persons) | **9,942** | **7,648** | **76.93** |
| No. of employees (thousand persons) | **7.336** | **5,047** | **68.80** |
| Total Sales (NT$ million) (US$ million) | **33,941,857 (1,033,238)** | **10,000,220 (304,421)** | **29.46** |
| Domestic Sales (NT$ million) (US$ million) | **25,310,936 (770,500)** | **8,481,397 (258,186)** | **33.51** |
| Export Sales (NT$ million) (US$ million) | **8,630,921 (262,737)** | **1.518,823 (46,235)** | **17.60** |

*(Source: White Paper on Small and Medium Enterprises in Taiwan, 2006)*

**Table 15 Enterprises Ages**

**units: no. of enterprises**

| Age | 2002 | 2003 | 2004 | 2005 | 2006 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Total enterprises | SMEs | % of SMEs |
| **Less than 1 year** | **91,435** | **112,154** | **108,610** | **125,667** | **108,673** | **108,320** | **8.71** |
| **1 – 2 years** | **94,036** | **104,183** | **110,649** | **108,989** | **121,466** | **120,530** | **9.69** |
| **2 – 3 years** | **77,477** | **82,234** | **87,612** | **96,365** | **92,503** | **91,400** | **7.35** |
| **3- 4 years** | **70,554** | **69,545** | **70,895** | **79,583** | **84,648** | **83,272** | **6.69** |
| **4- 5 years** | **63,851** | **64,843** | **61,321** | **65,055** | **71,610** | **70,133** | **5.64** |
| **5- 10 years** | **233,742** | **248,300** | **245,280** | **249,414** | **253,746** | **247,247** | **19.87** |
| **10- 20 years** | **279,065** | **283,225** | **287,444** | **298,662** | **299,282** | **290,121** | **23.32** |
| **Over 20 years** | **194,546** | **207,296** | **218,365** | **229,959** | **240,580** | **233,076** | **18.73** |
| **Total** | **1,104,706** | **1,171,780** | **1,190,176** | **1,253,694** | **1,272,508** | **1,244,099** | **100** |

*(Source: Collected from Ministry of Finance Tax Data Center Business Tax statistics.)*

**Eleven guidance programs to assist SMEs**

- Finance and Credit Guidance System
- Management Guidance System
- Production Technology Guidance System
- Research & Development Guidance System
- Information Management Guidance System
- Industrial Safety Guidance System
- Pollution Control Guidance System
- Marketing Guidance System
- Mutual Support & Cooperation Guidance System
- Quality Enhancement Guidance System
- Business Startup & Incubation Guidance System

**Policies for fostering SMEs and new startups**

Philosophy – Service, Minding, Esteem, Awareness

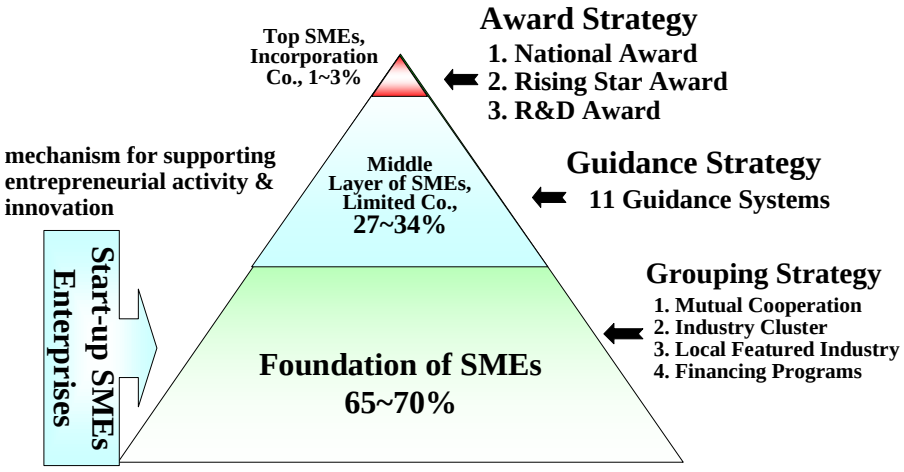



**Fig 18 Policies for fostering SMEs and new startups**

*(Source: SMEA, MOEA, Chinese Taipei)*

## 4.6. Government Policy Tools to Encourage Technology Collaboration among SMEs, Universities, and Research Institutes

**Stipulate science and technology basic law**

- Taiwan stipulated the Science and Technology Basic Law in 1999.
- Due to the enactment of this law, institutes or personnel who produce valuable outcomes in a government-funded research can retain the ownership and therefore enjoy the benefit generated from it.
- This will encourage universities to attend government-sponsoring industry-university collaboration programs.

**R&D programs for industry-university collaboration**

- The government launched in 1992 a project to encourage the industrial and academic sectors to jointly form a research team to conduct R&D of innovative technologies.
- The project provides each approved case with R&D fund between 155 and 310 thousand US dollars, and the participating enterprises need to pay for 25% of total research cost.
- In addition to this general project, another project targeting on SMEs has been launched in 2002. This project is aiming to enhance the SMEs' R&D capabilities through practically involving in a R&D project with universities. Both projects require enterprises' involvement in the research.

**Industry-academia-government collaboration and incubation value-added project**

- Goal
  - To establish Innovative Core SMEs with Global Competitiveness
  - Industries are lead toward an economic development breakthrough.
- Objectives
  - To build up a friendly environment for start-ups and to take root in sustainable development
  - Constructing R&D service and local incubation supporting network, in order to boost up capability of incubation center
  - Enhancing Industry-Academia-Government collaboration to strengthen its influence and support start-ups
  - Incubating 800 start-ups within 2008~2011.

- Project Structure

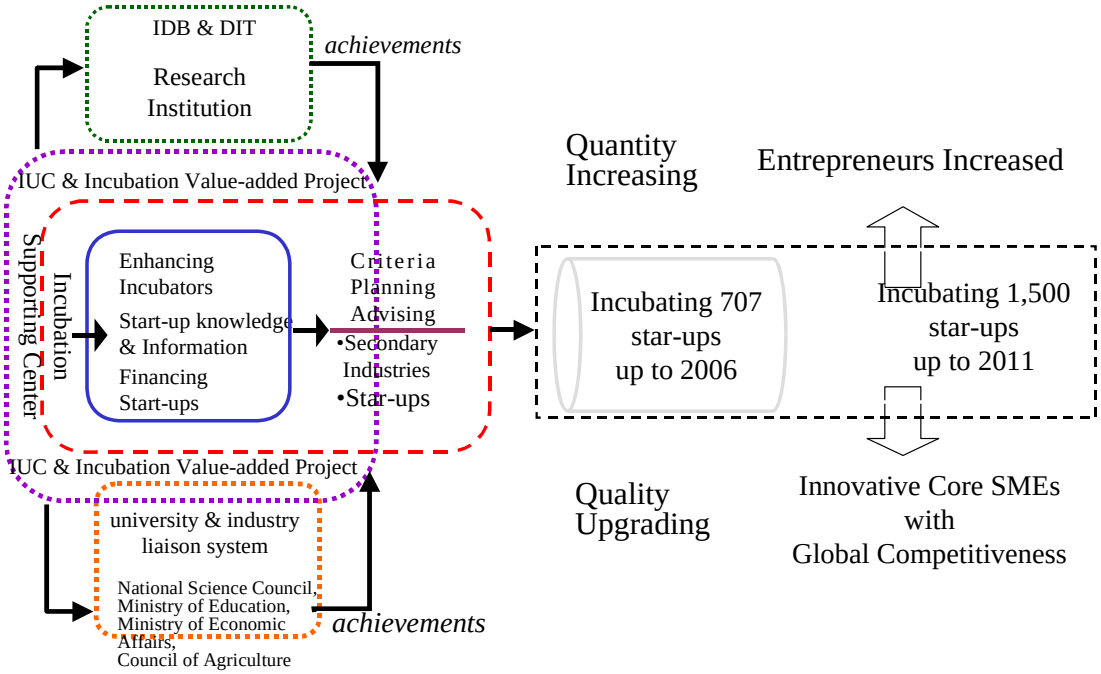



**Fig 19 Project Structure**

*(Source: SMEA, MOEA, Chinese Taipei)*

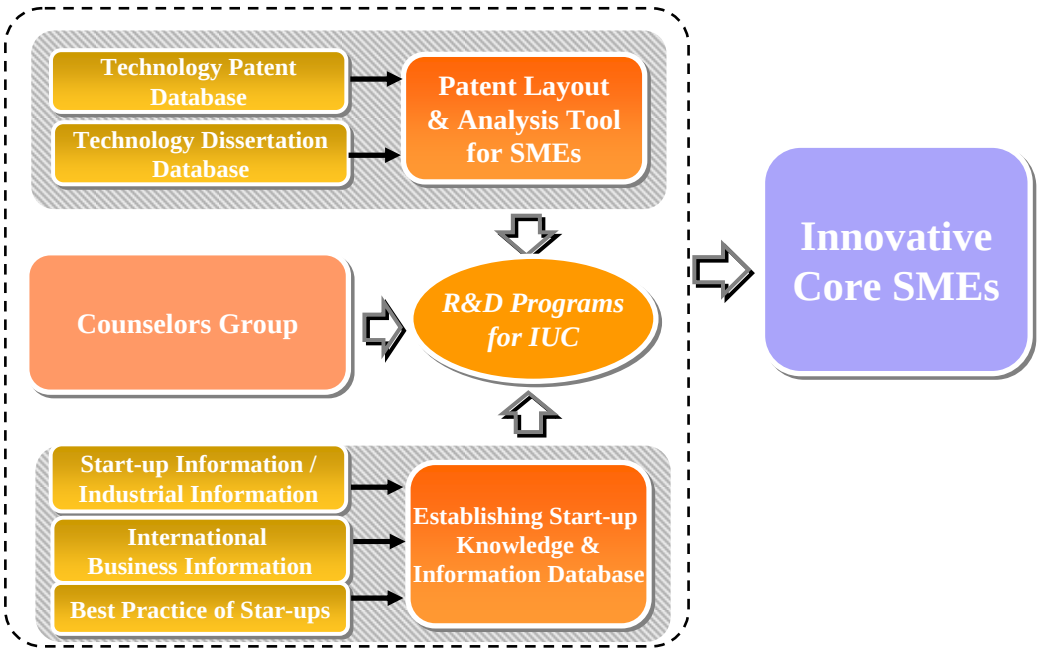



**Fig 20 R&D Programs for Industry-University Collaboration**

*(Source: SMEA, MOEA, Chinese Taipei)*

**Business incubation service**

- Ninety eight Business Incubators , over 85% of which were located in universities
- One of the main functions of Business Incubators is to be an important channel for industry-university collaboration. Through strengthening the interactions between the two parties, the technological level of SMEs can be enhanced.
- Locating incubators in universities will help release the resources of universities to industry, and therefore assist SMEs in innovation.
- Business Incubators in Taiwan have become an important platform for cross-industry collaboration within the national innovation system.
- Functions
  - To reduce risks and expenses of investment and increase successful rate of start-up enterprises
  - To foster new products, new business-model and new technology
  - To provide guidance in commercializing R&D achievements
  - To provide a location for cooperation of academia and industries
  - To provide testing services and speed up the development of products
  - To provide training courses, information and consultation

**Incubation supporting center**

An incubation supporting center should have complete facilities, experts, technology and business incubating system; and should be capable of integrating multiple resources to lead and to support star-ups in a geographical area. It could stimulate business activities and expand global market.

Four to six incubation supporting centers of green industry, local cultural industry, woman entrepreneurship and global marketing will be established during 2008~2011, and planned in advance in 2007.

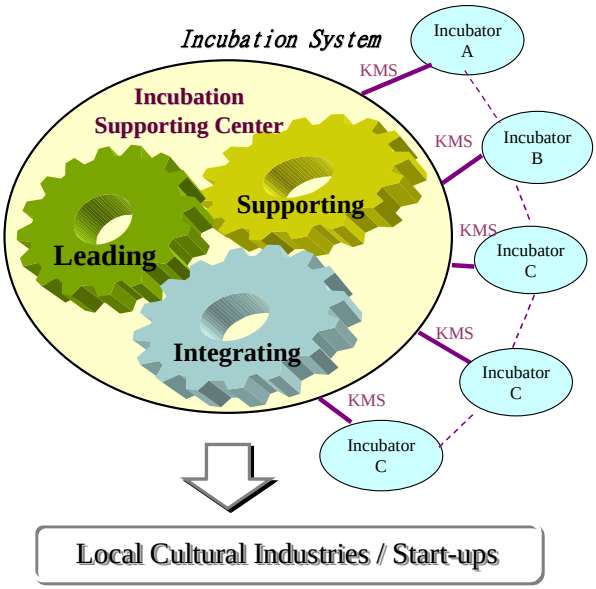



**Fig 21 Incubation System**

*(Source: SMEA, MOEA, Chinese Taipei)*

Small Business Innovation & Research Projects

- US$60 million for 1,200 projects (Jan.-June, 2007)

Strategic R&D Alliances for SMEs & Big Enterprises

- A practice of Flying Geese Theory
- US$625k for each alliance

Innovation & Research Promotion Projects for Local Industries

- County/City-based
- US$2 million in 2007, will enlarge project scale in 2008

The manufacturing sector has been the key driving force for Chinese Taipei's economic development. Over the past 50 years, the government and the private sector have been working together to continuously enhance industrial competitiveness and to achieve steady economic growth. As a result of these efforts, Chinese Taipei has become the global center for IC foundry services as well as a manufacturing powerhouse for many high-tech products. In response to the keen competition in the world market stemming from globalization, one of the

most significant efforts of what the government has made is to enhance SMEs' competitiveness through the promotion of technology collaboration. It is hoped that industries will continuously develop and strengthen their position in "high value-added" production and services.

## 4.7. ITRI's Collaboration Program of OpenLab

**A dual mechanism for technology collaboration**

Over the past eleven years, ITRI's work to help enterprises engage in innovative R&D and assist new start-up companies through its Open Laboratory (OpenLab), which can be divided into Technological Business Incubator and Collaboration Program, has created a healthy environment for creation and innovation. ITRI OpenLab has proved to be a very successful experiment, greatly benefiting the development if Chinese Taipei's SMEs.

In ITRI's main Campus and southern branch, the staff of resident OpenLab companies interacts frequently with ITRIers. As many as 700 to 800 ITRI employees take advantage of business lunches with their industry counterparts to engage in idea- and opinion-exchanges each day. Through such close, interactive relationships, ITRI, is creating synergy between itself and product-oriented resident companies in the OpenLab.

ITRI's cooperation model is tighter than any other research organization and Business Incubator around the island. ITRI's overall environment is more conducive to generating high levels of trust between resident companies and their international cooperation partners.

Since most SMEs are with limited internal resources, ITRI OPenLab provides companies with the support they need most such as industry information, technical transfer services, and industry assistance for obtaining government-led funding and reward projects, and general industry consultancy services. These are combined with outside resources such as finance, venture capital, accounting, intellectual property, legal, equipment leasing and other services to provide resident companies with all the services and assistance they require. This has created a comprehensive 'total solution/one-stop shopping' environment.

To help Taiwan's SMEs compete on an international scale, ITRI is actively encouraging firms to develop various new technologies by means of strategic alliances.

ITRI's research work and the entrepreneurial environment created through its principle of total asset management have created an important hub for the agglomeration of talent. Thus, ITRI's abundant experience and boundless energy in R&D, industrial relations, patents, contracts, legal issues, company start-up assistance, and other areas make it the best possible partner for providing research and entrepreneurial teams with the most effective assistance.

### 4.8. Lessons Learned

Through years of hard work, the R&D collaboration program has enlarged the opportunities for domestic SMEs to perform innovative research and development, being able to solve problems such as too small a scale and a shortage of development ability. On the other hand, R&D collaborations can stimulate mutual integration across the upstream, midstream and downstream industrial sectors to come up with new products or services, and help the industrial structure of Chinese Taipei based on manufacturing to gradually change itself into a structure centered on high value-added manufacturing. Additionally, the R&D collaboration program has stimulated research and development across different industries, and will effectively improve the industrial competitiveness of our country.

- Engaging in technological research was not enough. Being able to transform research results into a new venture is the true measure of a new technology's real merit. Although new technologies and enterprises are subject to greater levels of risk in the early stages of their development, they are also open to greater opportunities.
- Government policies should follow an open and competitive market mechanism.
- Basic principles for industrial development:
  - Strong market potential
  - Close interrelations among industries
  - High value-added
  - Appropriate technology
  - Low pollution, and low reliance on energy

## 5. Discussion

- **What kinds of knowledge, skill, and attitude are required in technology collaboration?**
- **Tips for project management**
- **Inventorying key factors owned to success**

## 6. Conclusion

The key to the success of SMEs-academia-PRI technology Collaboration is to construct the "nodes" linking the three parties. The government may catalyze and provide the cooperative incentives for each party. According to Chinese Taipei's experience, the ways in which government can adopt may include:

- Helping the academia to build Business Incubators, Technology Transfer Centers, and Regional Collaboration Centers as main intermediary mechanisms to promote Technology Collaboration
- Launching vital projects to sponsor the joint research among SMEs, academia, and PRI
- Bettering human resource development by encouraging academia to offer technology/management training courses to SMEs' personnel
- Establishing talent database including the researchers from the industry, academia, research organizations, and overseas.

How to encourage the academia to participate proactively is the most important part to pursue SMEs-academia-PRI Technology Collaboration. Adequate incentive should be provided and some institutional reconstruction or even cultural changes are also necessary.

## 7. Reference

2006 Taiwan Industry Outlook, IT IS Program Office, Department of Industrial Technology, Ministry of Economic Affairs, Chinese-Taipei, 2006

Amabile, T. M., "A Model of Creativity and Innovation in Organizations," in B. M. Staw & L. L. Cummings (Eds.), Research in Organizational Behavior, 10, Greenwich, CT: TAI Press,1988

Allen ,D. N. and V. Levine, "Nuturing Advanced Technology Enterprises: Emerging Issues in State and local Economic Development Policy," New York: Prager, 1986

Amabile, T. M., "Assessing the work environment for creativity," Academy of Management Journal, 39(5), 1996

Audretsch, B. D. and M. P. Feldman,"R&D Spillovers and the Geography of Innovation and Production," American Economic Review, 86, 1996

Baldridge, J. V. & Burnham, R. A., "Organizational Innovation: Individual, Organizational, and Environmental Impacts," Administrative Science Quarterly (20)

Brown, W. B. & Karagozoglu, N., "A Systems Model of Technological Innovation," IEEE Transaction on Engineering Management, 36(1)

Chiesa, V. Coughlan, P. & Voss, C.A., "Development of a Technical Innovation Audit," IEEE Engineering Management Review (26), 1998

Drucker, P. F., "Innovation and Entrepreneurship-Practice and Principles," Harper & Row, New York, 1986

Frankle, E.G., "Management of Technological Change," Kluwer Academic, 1990

ITRI, “Annual Reports, 1995-2006,” Industrial Technology Research Institute

ITRI, “Industrial services Databank,” Industrial Technology Research Institute

ITRI, “Visible Brain”, 2007

Keeble, D., Moore, B., D. Keeble, C., Lawson, “University and Technology-Intensive SME Research Collaboration, Spin-Offs and Recruitment in the Cambridge Region,” University Research Links and Spin-Offs in the Evolution of Regional Clusters of High Technology SMEs in Europe, 1997

Len Polizzotto, Vice President, SRI International,“The Exponential Economy, Value Creation and the Discipline of Innovation”, 2006

Lee, W. H., Yang, W. T., “The Cradle of Taiwan High Technology Industry Development-Hsinchu Science Park (HSP),” Technovation, 2000

Leonard, C., “Bridging the technology transfer gap: cooperative partnerships between education and industry,” Industry & Higher Education, Vol. 7 No. 3, 1993

Lu, Ta-Jung; Wann, Jong-Wen, “Entrepreneurship from Internal to External through Strategic Planning –The Typical Experiences of Public University's Innovation Incubators in Taiwan,” International Journal of Innovation and Incubation, 2004

Mian, S.A., “An Assessment of university-sponsored Business Incubators in Supporting the Development of New Technology-Based Firms. Unpublished doctoral dissertation,” George Washington University, Washington, DC., 1991

Mian, S.A., “Assessing Value-added Contributions of University Technology Business Incubators to Tenant Firms,” Research Policy 25(3), 1996

MOEA, “Project Management Databank,” Ministry of Economic Affairs, Chinese-Taipei

Saxenian, A., “The Silicon Valley-Hsinchu Connection：Technical Communities and Industrial Upgrading,” SIEPR working paper, Stanford University, 1999

Saxenian, A., “Taiwan's Hsinchu Region: Imitator and Partner for Silicon Valley,” SIPER working paper, Stanford University, 2001

Storey P., Westhead D. J., “Links between Higher Education Institutions and High Technology Firms,” Omega International Journal of Management Science, 1995

Raykun, R. T., “Establishing Technology Transfer Infrastructure as a Strategy for Promoting Manufacturing Automation in Taiwan,” Technovation (15), 1995

Robert S.Q. Lai, “Industry-Academia-Government Collaboration for SMEs in Taiwan”, Sep. 2007

Rosenberg, N. & Frischtak, C., “International Technology Transfer,” Praeger, New York, 1985

Rothwell, R. & Zegveld, W., “Industrial Innovation and Public Policy,” Frances Pinter Ltd.,

London, 1981

Rothwell, R., “Successful Industrial Innovation: Critical Factors for the 1990s,” R&D Management (22), 1992

Sbragia, R., “Clarity of Manager Roles and Performance Do R&D Multidisciplinary Projects in Matrix Structures,” R&D Management (14), 1984

Smith, K., “Interactions in Knowledge System: Foundations Policy Implications and Empirical Methods,” STI Review (16), 1995

Stuart, T. E. & Podolny, J. M., “Local Search and the Evolution of Technological Capabilities,” Strategic Management Journal (17), 1996

Thompson, V. A., “Bureaucracy and Innovation,” Administrative Science Quarterly (10), 1965

Utterback, J. M., “Innovation in Industry and the Diffusion of Technology,” Science, Feb.1971

Wen,Chao-tung, “The Formation & Development of Industrial research capability in Taiwan-A Case Study of IT IS,” APO Symposium of Technical Information Mechanism for Small Industries, Asia Production Center, Sep. 2000

Wield P.,Massey D., “Academic-Industry Links and Innovation: Questioning the Science Park Model Quintas,” Technovation 1992

# Chapter 3. Business Incubation

Rern-jier Sheu[1]

Since the world's first business incubator, the Batavia Industrial Center opened in 1959, the establishment of business incubators is now a common policy among APEC member countries and economic entities. With the purpose to increase the success rate of incubates, business incubators are where individuals or businesses receive assistance to develop and commercialize new products, new technologies, or even new services. Some incubators also help existing firms to enhance their chances of success.

The achievement of Chinese-Taipei's SMEs has been the object of intensive study in other countries. Active participation in the meetings and activities of international economic and trade organizations by both the government and the private sector provides opportunities to share experiences and learn from each other in SME development among countries and economic entities. Chinese-Taipei is ready to share its incubation experiences with other APEC members.

Developed with input from experienced professionals, the course will provide a real-world view into the best practices of incubator establishment and management. Participants will develop skills and gather tools to enhance the success of their incubator policy-making and management.

## 1. Introduction

### 1.1. Preface

SMEs have been responsible for creating wealth and jobs worldwide. Globally at the moment, Business Incubators are growing in numbers. Incubator programs have been established in many countries to stimulate creation of technology-oriented and business model-innovated SMEs. They have been shown to reduce the failure rate of SMEs by providing training and guidance to such companies in their initial stages. Businesses being incubated today are at the forefront of developing new technologies/business models, and are producing new products and services to create economic value. Among them, high-technology new ventures have been particularly successfully incubated in APEC members such as the U.S.A., Korea, and Chinese Taipei.

A Business Incubator (BI) is a place where individuals or enterprises nourish their new products, new businesses and new technologies, and engage in enterprise transformation and upgrade. Its aim is to create a better cultivation environment for new enterprises. Therefore, BIs provide SMEs many kinds of integrated services needed for entrepreneurship and innovations. These services include experimental facilities at pilot stage, operation space, technical support, administrative assistance, business services, fund raising service, and other assistance for businesses to make innovations and growth. It aims to help new ventures to survive from the fragile infancy. During the past fifty years, the achievements of Business

[1] Senior administrator of ITRI College, ITRI (Industrial Technology Research Institute), Chinese Taipei

Incubators in helping new ventures have won credits far and wide.

As an engine to drive technological innovation and economic development, high-tech ventures are attracting much more public attention in most APEC member countries. Fostering entrepreneurship and promoting venture creation have become important public issues.

Since incubators' main functions are to foster new technologies and start-ups, they play a critical role in innovation and technological upgrades. In the United States, SMEs have been responsible for half of all innovation and 95% of all radical innovation. But in most cases of the rest of APEC members, SMEs do not have enough capability to conduct successful innovation although they account for the absolute majority of firm number. So how to provide a comprehensive and practical overview of the tasks and responsibilities of incubator management from a government's point of view is critical.

The aim of this course intends to highlight the critical role of incubation industry on the development of the innovation system and, vice versa, the importance of the innovation system for breeding the particular environment for successful incubator network, together contributing a nation's prosperity.

**Why this program?**

After the training course, trainees are expected to:

- Develop an international perspective for business incubation
- Identify key factors that can turn business incubation mechanism into a more effective tool
- Increase the ability of incubator management both at macro and micro levels
- Steer related business incubation policies in the right direction to meet the needs of national economy development
- Establish friendship as the step stone for further cooperation among trainees

**Expected benefits**

Trainees will gain practical knowledge to help them:

- Have a clear picture for related policy-making
- Build stronger government, incubator management, and stakeholder relationships
- Provide better coaching to business incubator management
- Help government to bettering resources allocation
- Establish effective projects for business incubator development
- Increase incubators' impact in the country

- Build up an international networking for both incubator management and policy-making

Networking among BIs will be helpful in accelerating growth of managerial abilities and incubatees across country borders. Incubators may be clustered in virtual or physical space, and make better use of resources. It also may provide a good opportunity for the management team of APEC member incubators to further develop skills and knowledge at global best practice levels.

**A check list of your needs**

Please fill in questions:

1. Did you ever involve in the management/policy making of Business Incubators?

☐ Yes ☐ No

2. How many Business Incubators do you have in your country?

☐ None ☐ Less than 10 ☐ 10~50 ☐ 51~100 ☐ More than 100

(If your answer is “None,” please stop answering the following questions.)

3. Your first Business Incubator has been established for

☐ Less than 5 years ☐ 6 to 10 years ☐ More than 10 years

4. The main objective of Business Incubators in your country is

☐ To promote national economy development

☐ To promote local/community economy development

☐ Both

5. The major purpose of most of Business Incubators in your country is (multiple choices)

☐ To increase employment (quantity/quality)

☐ To encourage entrepreneurship

☐ Technology commercialization

☐ New business model development

☐ As test beds for new policies/regulations

6. Legal entities of the majority of your Business Incubators are

☐ Public/State own

☐ Universities/colleges

☐ Not-for-profit organizations

☐ Profit-seeking companies

7. Your evaluation on the performance of your domestic Business Incubators in general is

☐ Need much to be improved

☐ Need to be improved

☐ Fair

☐ Good to excellent

8. Key success factors or major problems of your Business Incubators are:

(Please identify three factors/problems.)

## 2. Related Theories, International Major Incubators & Policies at a Glance

### 2.1. What are “Business Incubators”?

When Joseph L. Mancuso started the first U.S. Business Incubator in the small upstate New York community of Batavia in 1958, the concept of business incubators has spread around the world. In nowadays, at least 4,000 Business Incubators have been established around the world. The term “Business Incubator” has become a popular tool for economic development in most countries.

Listed below are some definitions about them.

**A Business Incubator** can be defined as a controlled work environment designed to foster the growth of new and emerging companies. *(NBIA, 1998)*

**The Business Incubator** is a physical space or facility that accommodates a business incubation process.

**Business Incubation Process** is a public and/or private, entrepreneurial, economic and social development process designed to nurture business ideas and start-up companies, through a comprehensive business support program, help them establish and accelerate their growth and success.

**The Business Incubation Environment** is the wider context which should be conducive to the sustainable nurturing of growth potential and the development of enterprises. *(Mr. Heinz Fiedler, President of SPICE Group, Germany)*

**Business Incubators** are organizations that support the entrepreneurial process, helping to increase survival/success rates for innovative startup companies or new businesses for existing companies. Entrepreneurs with feasible projects are selected and admitted into the incubators, where they are served by a specialized package of support resources and services.

**A Business Incubation Program** is an economic and social development process designed to advise potential start-up companies and, through a comprehensive business assistance program, help them establish and accelerate their growth and success. The main goal is to produce successful businesses that will leave the program, in a timely manner, financially viable and freestanding. These graduates create jobs, revitalize communities, commercialize new technologies and create wealth for local and national economies. Critical to the success of a Business Incubation Program is:

- Management that develops and orchestrates business, marketing and management resources and relationships tailored to the needs of the business clients
- Shared services, training, technology support and equipment
- Selection of clients and acceleration process by which businesses become more independent and progress to graduation
- Assistance in obtaining the financing necessary for business growth
- Business Incubation Programs gain added value by providing access to appropriate rental space and flexible leases in an incubator facility.

*(The comprehensive definition adopted by the International Summit in Richmond, USA, May 2003)*

Resources and services for incubatees may include some diverse items such as provision of physical space (offices, labs, pilot run facilities), management coaching, help in preparing effective business plans, administrative services, technical/technological support, business networking, intellectual property aids, and finding financial source.

A successful Business Incubator shall be based on the integration and synergy by combining human, entrepreneurial components with economic potential and innovative approaches. *(Mr. Heinz Fiedler)*

Concluded from previous successful cases, benefits that result from business incubators may include:

- Local/national promotion of economy
- Creation of job, wealth, intellectual property
- Technology commercialization
- Smoother transition of research results of academia and research institutes to new companies
- Increased international competitiveness and etc.

**Table 1 A Comparison of Similar Terms**

| Type | Physical Scale | Main Function |
|---|---|---|
| Business Incubator | From a single building to a | To promote the development of new ventures |

| | | |
|---|---|---|
| | campus<br>Small<br>(some are in virtual style) | |
| Innovation Center | Small to medium | Technology/new business model development |
| Research Park | Medium | Technology development<br>Some with incubation function |
| Science Park | Medium to big | Mass production with high-tech inside<br>Some with incubation function<br>One of the next stop for incubator graduates |
| Industrial Zone | Big | Mass production, most are non-high-tech<br>One of the next stop for incubator graduates |
| Technopolis | A town/city | To promote the overall development of a town or city mainly with technological ingredients |

**Major incubators in the world**

Randall M. Whaley Incubator of the Year by National Business Incubation Association (N.B.I.A.) is the highest award for global top incubators with excellent performance. Since 1996, N.B.I.A. established “Incubator of the Year” award beside “Randall M. Whaley Award” to encourage the rest of top incubators. Listed below are those awarded incubators since 1991.

(Incubators with (A) are winners of “Randall M. Whaley Awars”, and (B) for “Incubator of the Year” winners.)

- 1991: Colorado Venture Centers Inc. (formerly Business & Innovation Center) Golden, Colo., USA (A)
- 1992: GENESIS Technology Incubator, (formerly GENESIS Business Incubator), Fayetteville, Ark. USA (A)
- 1993: Brush Creek Enterprise Center (formerly Center for Business Innovation), Kansas City, Mo., USA (A)
- 1994: Austin Technology Incubator, Austin, Tex., USA (A)
- 1995: Rennselaer Polytechnic Institute Incubator Program, Troy, N.Y., USA (A)
- 1996: Advanced Technology Development Center, Atlanta, Ga., USA (A)

  Western Colorado Business Development Center, Grand Junction, Colo., USA (B)

  Omaha Small Business Network, (formerly Omaha Business and Technology Center) Omaha, Neb., USA (B)
- 1997: Technology Innovation Center, (formerly Evanston Business & Technology Center) Evanston, Ill., USA (A)

  Chattanooga/Hamilton Co. Business Development Center Chattanooga, Tenn., USA (B)

  San Francisco Renaissance Entrepreneurship Center, San Francisco, Calif.,USA (B)

- 1998: The Technology & Enterprise Center, Richland, Wash., USA (A)

  Colorado Technology Incubator (formerly Boulder Technology Incubator), Boulder, Colo. USA (B)

  The Denver Enterprise Center, Denver, Colo., USA (B)

- 1999: Entergy Arts Business Center, New Orleans, La., USA (A)

  The Enterprise Center, Philadelphia, Pa., USA (B)

  The Edison Technology Incubator/BioEnterprise, Cleveland, Ohio, USA (B)

- 2000: Software Business Cluster, San Jose, Calif., USA (A)

  Entrepreneurial Center Inc., Birmingham, Ala. USA (B)

- 2001: Ben Franklin Business Incubator Center, Bethlehem, Pa., USA (A)

  CREEDA Business Centres, Canberra, Australia (B)

- 2002: Quebec Biotechnology Innovation Centre, Laval, Quebec, Canada (A)

  Northern Alberta Business Incubator, St. Albert, Alberta, Canada (B)

- 2003: The Business Technology Center, Columbus, Ohio, USA (A)

  Toronto Business Development Centre, Toronto, Ontario, Canada (B)

- 2004: The New Century Venture Center, Roanoke, Va., USA (A)

  University of Central Florida Technology Incubator, Orlando, Fla., USA (B)

- 2005: The Louisiana Business & Technology Center, Baton Rouge, La., USA (A)

  The William M. Factory Small Business Incubator, Tacoma, Wash., USA (B)

- 2006: Industrial Technology Research Institute Incubator Center, Hsinchu, Tawain (A)

  Fulton-Carroll Center of the Industrial Council of Nearwest Chicago, Chicago, Ill., USA (B)

Besides the incubators listed above, there are many other famous incubators locate in China, Korea, Japan, and Europe. Some of them are namely as:

- China: Tsinghua Science Park/Incubator, Shanghai Technology Innovation Center /International Business Incubator, Beijing Zhongguancun Science Park/Incubator, Hong Kong Science and Technology Parks Corporation
- France: Sophia Antipolis
- Germany: Dortmund Technology Park, Technology Centrum Chemnitz (TCC)
- Japan: Kanagawa Science Park, Kyoto Research Park, Tsukuba Center, Kitakyushu Techno Park

- Korea: TBI at KAIST, Techno Parks in Daegu, Chungnam, Gwangju, Gyeonggi, Kyongbuk, Pohang, Pusan, and Gyenggi SME Center
- Malaysia: Multimedia Development Corporation, Kulim Technology Park Corporation
- Singapore: Nanyang Technological University
- The U.K.: Cambridge Research Park, MerseyBIO, Loughborough Innovation Centre

**Business Incubators in Chinese Taipei**

The business incubator catalyzes the processes of starting and growing companies. Primary goal of the business incubator in Chinese Taipei is to promote the development of technology-based firms, which are mainly, located near universities and science and technology parks. At the end of August 2007, there are totally ninety-eight incubators in Chinese Taipei.

**Policies trends**

■ **USA**

The incubator policy becomes one of the most powerful tools in the promotion of job opportunities and also improving regional economic development of the United States. Recently, a significant change in its incubator industry is that the industry now helps provide entrepreneurs with a variety of business support services such as complete business training plans, production flow support, product design and development, financial management, human resources management, etc.

Incubators provide business-training courses in a wide variety including corporate marketing strategies to the location of potential investors. They promote and provide opportunities for entrepreneurs, managers and local industry leaders to interact with one another. They also help start-ups from experienced consulting teams to overcome market entrance barriers. Another great change for the incubator industry, with the exception of the traditional mixed-use and technology-oriented incubators, is its development towards more specialized incubators, such as ceramics, carpentry, handcrafts, retailers, green technologies, etc.

**Table 2 Main Industry to Promote**

| Type of Industry | Percentage |
|---|---|
| Unlimited industry | 43% |
| High-tech industries | 25% |
| Manufacturing | 10% |
| Strategic industries such as biochemical, food, fashion, arts | 9% |
| Service industry | 6% |
| Licensing manufacturing | 5% |

| | |
|---|---|
| Others | 2% |

To promote the development of high-tech and cutting edge technological industries are not the major purpose for US business incubators.

**Table 3 Types of Founders**

| Types of Founder | Percentage |
|---|---|
| Local not-for-profit organizations | 35% |
| Mixture | 18% |
| Local governments | 14% |
| Universities | 13% |
| Private companies | 12% |
| Others | 8% |

**Table 4 The Average Structure of Revenue & Expenditure**

| Revenue | 100% | Expenditure | 100% |
|---|---|---|---|
| Rental | 60% | Personals | 37% |
| Subsidy | 40% | Facilities | 21% |
| | | Utilities, maintenance, training | 42% |

*Source: NBIA*

- **Australia**

With its unemployment rate gradually decreasing in recent years, the management patterns of SMEs have also gradually undergone change from the so called newly creation enterprise pattern moving to product commercialization or the exportation guidance pattern. Incubators of local networks relatively receive more resources and can actively act as an industrial promotion engine in domestic regions assisting the government to understand enterprise demands and providing policy suggestions to enhance the competitiveness of industry.

- **China**

There are more than 550 incubators with the following different types as compromise technology incubator, specialized technology incubator, overseas scholars innovation park, international Business Incubator, university–based incubator, business incubator network, etc. The advantages for business incubators operation in China include the government support, favorable policies, investment and sponsorship, etc. The challenges for Chinese incubators are

how to improve the innovation environment and the information infrastructure, reform the management, and the qualified managers.

The major characteristic of China's high-tech and new service incubators is that they are fully supported by government. Government's supports are from multiple aspects—the number of start-ups, incubator scale or amount of invested fund needed, number of employed, revenue.

- **India**

Due to its promotion of liberalization, the Indian government opened investment to many of its industries and has attracted a great deal of foreign direct investment in its domestic industry. The Ministry of Small Industry (SSI) is responsible for all related regulations to help SMEs and incubator development providing the collection of capital, information infrastructure, laboratories, management practice, and professional training, increase of worker skills, and marketing support of products and services.

The Small-sized Industry Development Organization (SIDO) is responsible for the planning, support, implementation, coordination and inspection of all policies and actual development flows. The National Small-sized Business Company (NSIC) is in charge of the promotion, supporting and nurturing of local SMEs. It also assists the SSI in the conduction of all kinds of programs, making SMEs technology upgrades, offers consultation support and services, business technology nurturing, and the encouragement of international cooperation setting up of small enterprises in other developing countries.

- **Japan**

Incubators along with Technology Licensing Organizations at universities play major roles in the cooperation between the industry and academia. Recent policies stress the establishment of four types of incubators namely as incubators for high-tech industries such as biotech and medical industries, incubators for industrial clusters, incubators to vitalize cities, and incubators for profit-seeking. On the other hand, to increase the competency of incubator managers by training is another focal point of its incubator policies.

- **Korea**

The rapid expansion of Business Incubators in Korea is one of the most important phenomena affecting its high-tech industries. Business incubation expanded very fast after the IMF bailout crisis.

The government strongly supports the development of incubation industry. In the fields of electronics, machinery, game, biomedical, Korean incubators have proven their abilities in incubating emerging high-tech new ventures. Recent policies have some focal points as :

- The establishment of financially self-sustain mechanisms for incubators
- To upgrade the managerial abilities of incubators

- To enhance the supporting systems such as education, professional consulting, marketing
- aids
- To extend supports from R&D and design to manufacturing and marketing

■ **Malaysia**

The National Incubator Network (NIN) was started in 2004 to attract technology entrepreneurs to gather in the Science Park of multimedia technology. Creating cluster effects is the main consideration of the policy. The other hot spot of Malaysian incubation industry is the establishment of Center for Health Innovation & Medical Enterprises (CHIME). CHIME is focusing on healthcare innovation, R&D, and the development for bioinformatics, and telemedicare industries.

■ **Singapore**

At the start of 1980, Singapore's policies were even more focus on the new capital intensive and high-value-added industries, high investment on the infrastructure facilities and construction. The manufacturing and service industries are "twin engines" driving for economic development and the attraction of foreign direct investment, and the upgrade of its industrial structure.

Since the 1990s, Singapore began setting up its research infrastructure and human capital training moving upward towards the top of the value system as it began to focus on the information technology industry. In order to effectively support the incubation system from all directions and aggressively promote its regional enterprises, the Singapore government provided ninety percent of the incubator fees for one year including daily operation fees and the salaries for the managers. Each subsidized incubator was thus in charge of nurturing at least ten companies annually. Each season the government will then conduct performance reports on the subsidized incubators. Funding grants are then decided based on their seasonal performance.

■ **Europe**

The European Community (EC) takes innovation as the starting point for emerging enterprises since it has realized that the commercialization and industrialization of science and technology are weaknesses for its industrial development. There are six major policies can be concluded as EC's recent efforts for incubation industry development:

- The education of entrepreneurship as the keystone of incubation
- Mutual sharing of the environment for the cultivation of small businesses
- The databank establishment of business start-ups incubated
- Financial aids programs

- Promoting by start-ups in emerging markets
- Heavily stressed on the incubation model of technological new ventures

■ **Latin America**

Latino American Association of Technology Parks and Incubators (RELAPI) is the major linkage organization for the incubation development in Latin America. Listed below are some major incubators in this region.

**Argentina**: More than thirty three incubators and twenty technology parks.

**Brazil**: With more than three hundred incubators, it has become the hot spot of technology new ventures in Latin America. Most incubators are directed by the Association of Companies Promoting Technology Innovation.

**Chile**: The establishment of Silicon Valley of Valparaiso has been supported by the government, universities, and some multinationals since 2004.

**Peru**: At least twenty five technology incubators conduct in the development of new ventures. Among them, UNALM and APESOFT are two of the best. Its incubation industry is still young and needs much more linkage of R&D and innovation.

**Panama:** Howard Special Economic Area and City of Knowledge are two of the major bases for Panama's incubation industry.

■ **Chinese Taipei**

In 1996 the Small and Medium Enterprise Administration (SMEA) of the Ministry of Economic Affairs (MOEA) took the lead in fostering the development of Business Incubators. The Administration devised three core strategies, focusing on Business Incubators, Entrepreneurial Knowledge and Information, and Financing Support for start-ups. These strategies were to form the basis for the creation of an SME incubation platform; helping its start-up SMEs to obtain the guidance and support their needs in the areas of technology, knowledge, funding etc. The goal was to build up a start-up learning mechanism that would contribute to the development of a knowledge-based entrepreneurial society and to the promotion of the incubator sector.

The Ten Key Individual Plans making up the Challenge 2008 National Development Plan included the Global Innovation and R&D Base Plan. One of the elements in this plan was the establishment of various types of innovation and R&D centers, with a sub-plan for developing Chinese Taipei into an "Asia Entrepreneur Center". The main objective was to build up a high-quality incubator network that would stimulate start-up and innovation activity, strengthen the competitiveness of domestic industry as a whole, and promote economic growth.

At present, the majority of Business Incubators in Chinese Taipei are affiliated to universities.

The MOEA has been encouraging research institutes and the private sector to invest in the Business Incubators, and has drawn up strategies for integrating different resources and strengths of incubators. The overall goal is to provide a comprehensive set of incubation services to cover each stage of the SMEs' development process.

*(Source: The Incubation Year Book, SMEA, MOEA, Chinese Taipei)*

## 2.2. Comparison among Major Types of Incubators

Business Incubators strive to promote entrepreneurship. The practices they implement should be based on identifying and addressing the specific needs of their target market of entrepreneurs. There are a number of key factors that determine success in establishing and operating incubators. We may classify incubators by different aspects such as:

- **Key partners involved in setting up Business Incubators**

  National authorities, international agencies, companies, banks, and other private sector organizations, universities and other R&D organizations, community and voluntary organizations

- **Legal status of Business Incubators**

  Public entity, private company, semi-public or others

- **Location**

  Urban, greenfield, rural, other

- **Types of incubator premises**

  New, converted, others

- **Physical space offered**

  Minimum, maximum, average, median

- **Roles and objectives**

  Contribute to competitiveness and job creation, help R&D centers commercialize know-how, help companies generate spin-off activities, help disadvantaged communities/individuals, or others

- **Types of firms origin**

  Start-up, branch of existing firm, spin-off from university or R&D center

- **For profit or not for profit**

  Each incubator around the world has its own historical background. The critical thing is that with what kinds of structure and elements can the incubator fit its mission and meet the performance required.

### 2.3. Workability Does Matter

The term “workability” here refers to be capable of being done with means at hand and circumstances as they are. Any great project stands only after it has been proven with workability.

Often, the feasibility study is used to determine and document a project's workability. The results of feasibility study are used to make a decision whether to proceed with the project, or dump it. If it indeed leads to a project being approved, it will—before the real work of the proposed project starts—be used to ascertain the likelihood of the project's success. It is an analysis of possible alternative solutions and a recommendation on the best alternative.

Advantages to conduct a feasibility study may include:

- Gives focus to the Business Incubator project and outline alternatives
- Narrows alternatives
- Surfaces new opportunities through the investigative process
- Enhances the probability of success by addressing and mitigating factors early on that could affect the project
- Provides quality information for decision making
- Helps in securing funding
- Identifies reasons not to proceed

The feasibility study is a critical step in the Business Incubator assessment process. After it has been done, a solid business plan for the Business Incubator project can appear.

## 3. Factor Analysis for Incubator Establishment

### 3.1. Identify Actual Needs

Incubators are locations for the cultivation of innovative businesses, products and technologies, and for helping SMEs to upgrade and transform themselves. By providing start-ups with resources required, they facilitate the effective integration of resources, helping to reduce the costs and risks that start-ups have to bear in the early stages of business development. With excellent incubation environments, incubators increase the likelihood that new businesses will be successful.

Normally, the objective for incubator establishment is to foster the growth of soundly run, competitive SMEs, and to help existing SMEs to upgrade and transform themselves, re-orienting themselves to the production of high-value-added products. Thus they can make a significant contribution to the local/nation economic development alongside larger enterprises.

But when a new incubation program launched, policy makers have better first identify the actual needs of the incubation program in both macro and micro levels.

Possible needs in macro level may include:

- To increase the employment of a nation both in quantity and quality
- To promote the development of national/local economy
- To enhance SMEs' abilities in technology and management
- To encourage commercialization of technology and new business development
- To test some new policies or regulations

For possible needs in micro level are listed as:

- To reduce the expenses of investment, and the level of risk involved, in the establishment of new start-ups and in the development of innovative technologies and products, thereby increasing the success rate for entrepreneurs and innovators
- To assist in the implementation of industry cultivation plans and in the development of new technologies and new products
- To provide guidance with respect to the commercialization of new products
- To provide a venue for collaboration between industry, universities and research institutes
- To provide testing services to speed up the process of product development
- To provide enterprises with consulting services in the areas of manpower cultivation, financing, information provision and operational management

*What are the actual needs of your Business Incubators?*

## 3.2. Goal setting

An incubator is very much like an enterprise; its objectives vary throughout the different stages of development, which require different strategies.

In the starting stage, mainly focused on creating superior nurturing environments to attract and foster new ventures. In the expansion stage, the tactic is building up a comprehensive incubation mechanism to accumulate strength for long-term development. While in the maturity stage, it is proactively bringing academic-industrial collaborative effects into full play to expand the knowledge based value chain. Management should carefully identify the critical resources and capabilities that are lack of and should be developed both internally and externally to fulfill its goals.

**SMART for goal setting**

- **Specific**—Goals must be specific.
  - Narrow down
  - 5 Ws + 1H—Who? What? Where? When? To whom? How?
- **Measurable**—Be able to measure progress towards goals.
  - Resources required
  - Planning
- **Attainable**—Goals must be something that can be actually attained.
  - Take an honest look at oneself and abilities
  - Determining actually wants
  - Find ways to get the
  - Start by setting smaller goals
- **Realistic**—Goals must be realistic, given who you are.
- **Abilities**
  - Be willing to accept the costs
- **Tangible**—Goals must be something can be experienced.
  - Mind and motivation
  - Visualize how it will be when goals have been reached.

## 3.3. Resources Overview

Inventorying both your available tangible and intangible resources, to see whether they can meet the requirement to fulfill ideal services provided by your Business Incubators below:

- **Space and facilities**
  - Provision of office space and facilities
  - Provision of shared laboratory equipment, machinery, instruments and public facilities
- **Business support**
  - Provision of operational consulting services
  - Specialist training, including practical, hands-on training
  - Assistance with public relationship, exhibitions and advertising
  - Provision of financing information and introductions to venture capital firms

- **Administrative support**
  - Provision of shared secretarial and administrative services
  - Assistance with company registration, business registration and factory registration
  - Provision of guidance for business plan preparation
  - Assistance with applications for guidance programs
  - Assistance with the drawing up of contracts and agreements
  - Software/hardware management and maintenance
  - Building security management.
- **Technology and manpower support**
  - Provision of high-quality, expert manpower
  - Technology transfer services
  - Arranging collaboration and alliances with technology development institutes
  - Technical manpower support
- **Information support**
  - Arranging the provision of specialist consulting services
  - Provision of information and advice regarding government guidance systems and government policies
  - Assistance with the collection of industry, market and technical information
  - Facilitating collaboration with industrial associations, specialist academic associations, local industry promotion associations and other organizations
  - Promoting the formation of strategic alliances, and encouraging collaboration between start-ups in the areas of marketing, market development, distribution, financing etc.
  - Promoting the development of collaborative relationships with local industry
  - Provision of information relating to science-based industrial parks and industrial districts, including application procedures, to help start-ups establish themselves in a science-based industrial park or industrial district after “graduation” from the incubation center

*If you do not have enough resources, which is in most cases, you have to develop some reliable networking and outsourcing abilities to make your Business Incubator attractive enough to meet the purpose of establishment.*

### 3.4. Development Strategies

Innovation is a continuous process of collaboration and learning for SMEs. Facing new prospects in the age of the knowledge economy, SMEs must not only enhance their value-added R&D innovation, marketing service and technology/new business model development. They also must establish a production/service deliver organization model that can adapt to more variety, less quantity, better creativity and stronger characteristics, to deepen their knowledge-based competitiveness.

The role of Business Incubators will become more important in the future as they are the hand that rocks the cradle of the birth of new ventures. They have to vigorously enhance the technical innovations and operational capacity, improve the quality of manpower, and promote the flexible use of knowledge in order to create the prosperity of industries and open the new horizon of national economy by fueling up the capacity for all-round economic development.

The foci of the continual development of Business Incubators may include:

- To form the incubation industry by expanding the guidance capacity of Business Incubators by
  - Encouraging private investments in the incubation industry
  - Encouraging corporate entities to participate in the work of Business Incubators
  - Combining local industrial development
  - Diversifying the fund sources of incubated enterprises
- To display the resource advantages of Business Incubators of different natures
  - To encourage Business Incubators to posit their areas of specialization

In the age of the “Innovation Economy,” the core value of a business is determined by its ability to innovate. Innovation is the power that pushes a business to growing, the fundamental motivation behind a society's development, and the spirit at the heart of a nation's advancement. Through a serial process of inter-functional teamwork or division of labor and skillful management, and the continuous integration of resources and application expansion, it reaches the market and in turn creates social and economic values.

However, in such a globalizing economy, SMEs can no longer stay with the traditional model of purchasing and selling, but must turn to being Internet-dependent composite, chain groups. As the development of the Internet speeds up the flow of information, business functions now not only cover the traditional transactions of commodity and service, but also involve the searching, exchanging and sharing of information. It is the crucial task and mission of Business Incubators to assist enterprises upgrade and transform.

### 3.5. Implement Timing

Timing is everything! This old saying can be applied to many complex situations.

Some tips of timing in conducting a Business Incubator project:

- Internal and external environmental scanning
- Market analysis (Incubation industry, new venture market, technology trends…)
- Stage of the life cycles of competitors/partners
- Construction scheduling
- Reduce lead time
- A stitch in time saves nine
- To be a bird or a worm—Early birds eat early worms

### 3.6. Backup Plan

**Murphy's Law**

The Murphy's Law broadly states that things will go wrong in any given situation, if one gives them a chance. It can be derived some tips below:

- "If there's more than one possible outcome of a job or task, and one of those outcomes will result in disaster or an undesirable consequence, then somebody will do it that way."
- "Whatever can go wrong, will go wrong."
- "If anything can go wrong, it will, and usually at the most inopportune moment."
- Backup plan is not a plan for failure. It is a plan to make you be more confident in dealing with obstacles.
- Sometimes the Plan B is a good idea.

Unless God, any given planing is always hard to meet one hundred percent accuracy of realities. Being a Business Incubator planer, one shall keep in mind that different backup plans are required to fit different stages of a Business Incubator's establishment and operation.

## 4. Case Studies on the Best Practice

### 4.1. Case Demonstration—Technology Business Incubator at KAIST HTVC

In Korea, about 350 incubators are in operation. External networking and outsourcing are

significant components Korea since most of incubators are not self-sufficient in providing services and support to incubatees.

The case of the Korea Advanced Institute of Science and Technology (KAIST), Technology Innovation Center (TIC)/Technology Business Incubator (TBI) is presented as one of the most successful Business Incubator in Asia Pacific area.

**Essential of TBI, KAIST**

- Started in 1994 with the support of the Ministry of Science and Technology
- The first and the largest business incubator in Korea
- HTVC hosts more than 130 high-tech new ventures and some companies for supporting fund raising, advertisement and education.
- More than140 new ventures have left HTVC.
- Among those new ventures, 51% successfully graduated, and 4% are in KOSDAQ.
- HTVC offers consulting services to its tenants by employing 5 business consultants who offer service at HTVC once in every two weeks.
- To join HTVC, a company should be a high-technology start-up and donate 1% of its equities to KAIST.
- A start-up company can stay in HTVC up to 6 years (3 years of incubation plus 3 years of post-incubation).
- There are many technology transfers and joint research projects between KAIST and HTVC companies.
- HTVC companies can easily access to KAIST equipment.
- KAIST has been the source of knowledge, new technology and distinguished manpower in Korea and will serve as the center of venture network.

**Excellent environment for technology-based venture business**

■ **KAIST**

- KAIST is a research-oriented university founded in 1971 by Korean Government.
- With 400 faculty members, 4,000 graduate and 2,500 undergraduate students.
- A top ranking university in Asia.
- The main campus is located at Daeduk Science Park in Dajeon, another campus hosting a business school is located in Seoul.
- Most of the funding for R&D at KAIST comes from the government, and about 20% from the industry.
- It has emphasized the development of innovative technologies and entrepreneurship. More than 300 technology-based ventures founded by KAIST graduates, and some of them are the most successful venture companies in Korea.

■ **Daeduk Science Park**

- Founded in 1971 as a research park in Dajeon.

- 68 research organizations in Daeduk Science Park including 20 national research institutes, 25 industrial research centers, and 4 universities.
- Encompasses more than 700 technology-based venture companies, which are mainly spin-offs from its research organizations.

**Strength and weakness of the venture environment in Daeduk**

- Easy to cooperate with research institutes.
- Good universities such as KAIST provide excellent graduates.
- Pleasant living environment.
- Daeduk Science Park is not close to Seoul in which major market is located.
- There is no world-class industry in the neighborhood of the park.

Korean government strongly promoted high-tech ventures in 1998 to overcome the difficulty in the economy, and supported HTVC to incubate additional companies. Now there are about 30% of HTVC companies are from KAIST and 70% are from outside.

Since 1998, SMBA started to give certificate to qualified-ventures (such certified-ventures have some benefits in taxation, funding, etc.), and 50% of HTVC companies were certified by SMBA.

**Services provided by HTVC**

■ **Space**

Two independent buildings (10,000 ㎡) for companies, the rental fee for incubation is about 50 per cent of outside buildings (market price).

■ **University facilities**

Libraries and gym can be used without extra charge.

Computer network is provided with a minimal change.

University research equipment can be used at actual expense

■ **Consultation and support**

Free consulting services.

HTVC provides its companies with some funds for technical consultation and for joining an exhibition.

■ **Education**

Venture business experts present once in every two months.

The graduate school of management at KAIST offers the Advanced Venture Management (AVM) program.

■ **Supporting companies**

Venture investment, advertisement, and cyber-education

KAIST Venture Network (KVN) connects about 800 KAIST-related ventures.

HTVC Brain Network (HBN) consists of outstanding business consulting companies.

To help HTVC companies obtain valuable information about marketing and management

**Key success factors**

- **Strong government support**

  HTVC provides with its companies various cost-free services and furthermore some funds for consultation and exhibition.

- **Technical cooperation with KAIST and other research institutes**

  Collaboration between HTVC companies and research organizations in Daeduk Science Park has helped develop new products.

- **KAIST graduates**

  Many KAIST graduates joined HTVC companies.

  KAIST has been a source of outstanding manpower.

  *(Source: KAIST)*

If several ministries are involved with the business incubation, always as the result, there has been duplicating investments. It will be better for one ministry providing support for the business incubation.

## 4.2. Criteria for Being an Excellent Incubator

Seven most important factors for the effective operation and management of Business Incubators:

- Clear goals and operating strategies of Business Incubators linked to local demands
- Well-defined policies and procedures for screening and supporting activities
- Expertise of Business Incubator managers and staff members
- Organizational structure such as decision-making process and roles of board
- Size and sources of budget and degree of self-sufficiency
- Contents and effectiveness of services
- Entrepreneurial network with external experts and financial sources

**What make an excellent Business Incubator?**

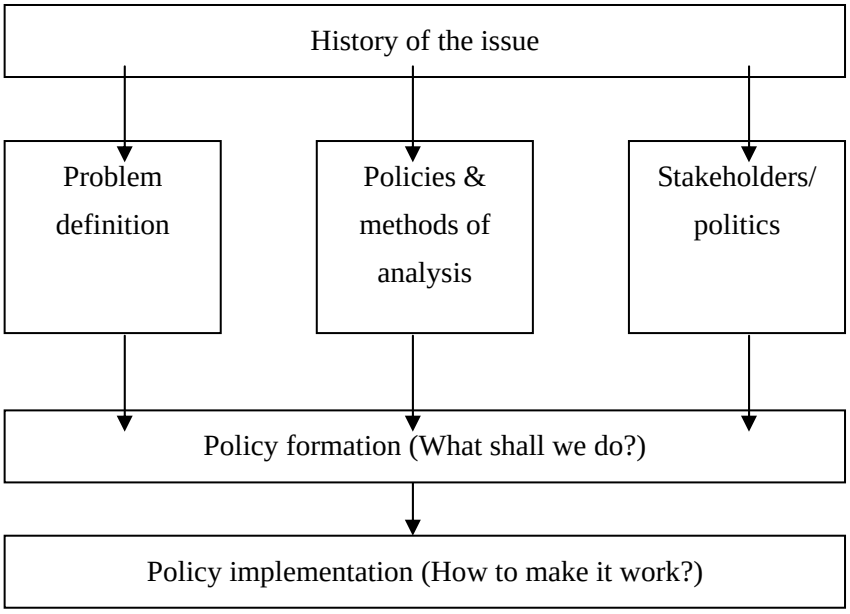
- An effective incubator is based on legitimate feasibility studies and business plans.
- An incubator is not a building, it is a service program.
- Best incubators are well managed. They provide appropriate salaries and benefits to their employees and shareholders.
- Stress on flexibility and commitment to service.

- Incubator managers are proactive in the provision of services.
- An incubator knows its mission. Its management, board, and staff clearly understand and work to support that mission.
- The best incubators are integrated into their community networks, resources, and economic development plans and strategies.
- An incubator's management time is focused primarily on serving clients rather than managing buildings, raising money, or conducting in political activities.
- Incubator managers engage in continual learning since business incubation is only a few decades old.
- Incubator managers are committed and idealistic. They take actions to fulfill dreams.

*(Source: Ms. Dinah Adkins, President & CEO, National Business Incubation Association)*

## 5. Focal Points of Policy Making

### 5.1. Value Creation through Policy Making




**A typical process of policymaking**

There is no question that effective policy-making requires lots of process. But in the end, it requires decisiveness too. While stakeholders value the opportunity to participate, they also expect efficiency in the process of analyzing issues and bringing them to resolution.

Every Business Incubator pursues specific strategies to achieve its mission and objectives. Here are three critical factors to be kept in mind in the policy making of Business Incubation:

**1) Adding value to the community**

- What kind of companies should be incubated? (What are incubatees' target niche

markets?)

- How much should be done to incubate them? (With what level and type of responsibility the incubator will assume to help and work with target markets.)

Issues:

- Degree of responsibility for creating and managing resources critical for incubation—Inactive, Selectively Reactive, Active, Proactive.
- Industry/Market Focus—The desirable group of incubatees
- Service emphasis on individual or group of firms—on an individual or collective basis

**2) The business incubation process**

- Using practices that address entrepreneurial needs
- Incubation relationship with incubatees is a delicate balance between support and pressure

**3) Incubation program structure**

- Incubation process may be differentiated from incubator to incubator on the basis of the specific entrepreneurial needs they address and the practice they use.
- There are many works to be done to clarify the particular strengths and weaknesses of different types of Business Incubators.

**Conceptual building**

Please identify features of a Business Incubator:

- An answer to solve all problems
- A tool to foster innovation
- A process supporting economic as well as social and technological development
- A mechanical apparatus
- Merely a building for new ventures' residency
- Shall be based on its adaptability to local needs and potentials

Business Incubators' main components are:

- Entrepreneurship
- Innovation
- Markets
- Networks

- Partnership and cooperation

## 5.2. Select & Focus

There is no individual or organization with abundant resources without limit. For a Business Incubator, it always has to face too many expectations from stakeholders. Therefore, it must learn how to make the better use of its available resources. A common error for project planners is that they know addition and multiplication of the four fundamental operations, but they seldom know how to utilize subtraction and division. To learn how to select few but critical targets and then put most resources on them is a must. After that, to establish effective platforms are always required to make things happen. Below is a practice from Chinese Taipei for reference.

To establish an SME start-up and innovation development mechanism under the Asia Entrepreneur Center framework, the SMEA of Chinese Taipei has set three major strategic objectives:

- To establish an incubator network that would strengthen the incubation of start-ups in Taiwan
- To build up a start-up knowledge and information platform that would stimulate the development of a knowledge-based entrepreneurial society
- To establish sound, effective financing channels to stimulate investment in start-up activity

It was anticipated that the creation of first-rate innovation and start-up mechanisms would facilitate the cultivation of innovation-oriented enterprises, provide entrepreneurs with access to the resources they need at different stages during the business development process, and make possible the development of a high-quality start-up incubation environment.

## 5.3. Build up Effective Mechanism

**Definition of mechanism**

※ The arrangement or relation of the parts of anything as adapted to produce an effect.

Business incubation is a dynamic process of business enterprise development. Incubators nurture young firms, helping them to survive and grow during the startup period. Although many incubators are quite successful in terms of the success rate and the growth rate of tenant companies, their contributions to the sponsoring entities, however, are still not satisfied in general. It is found that behind the glorious records there are still some barriers impeding the development of an efficient incubator. By applying a new model integrates merits of different types of incubators can be useful for the improvement of incubator performance. Beside the

promotion of economic development, a successful incubator shall earn profits/surplus not only for its own financial sustainability but also for generating significant equity return to its founder in the long run.

Major services provided by incubators may be as follows. It can be called as the seven Ss to start, survive, and succeed:

- Space for working and growing – it should be affordable, flexible, and modular
- Shared facilities such as office equipment, receptionist, conference rooms
- Services for improving – counseling on marketing/finance, information, promotion
- Skills development for tenants in business planning and management development
- Support for accessing university faculty, facilities and students, professional networking
- Synergy to do cooperation-competition through tenant interactions, clusters, and spin-offs
- Seed capital such as in-house revolving fund, access to credit, royalty, and risk capital. Many studies were carried out to identify success and failure factors

(Dr. Lalkaka, 1997)

Those services should be arranged as a portfolio/package to serve incubatees. An effective mechanism of a Business Incubator heavily relies on how to properly allocate and deliver these services.

## 6. Build Up Efficient & Effective Management Teams

### 6.1. Functions Required

An efficient and effective management team of a Business Incubator shall have ten functions to perform as an A-class business.

**1) Comprehensive business assistance**

The value-added services that characterize a successful incubation program are broad. The ability to coalesce these services into a comprehensive business assistance program designed to successfully nurture emerging ventures must be the ultimate objective of a best practice incubator. The assistance program shall follow a logical progression of steps.

First, the management team of a Business Incubator shall be able to identify client needs in an ongoing process. The role of needs identification is to provide a benchmark for screening new applicants, allowing staff to assess if the ventures are ready for incubation and if the incubation program has adequate value-added services to fulfill the applicants' needs. The role also has to clarify actions to be taken and resources to be mobilized by clients as well as

incubator staff during coaching and facilitation activities.

Secondly, the management team shall play the role of coaching and facilitation. The team shall be able to provide incubatees with outside perspectives of their businesses, and allow for strategic thinking that principals might neglect due to the pressures of dealing with the daily operation of the businesses. A mechanism for continually assessing and fulfilling clients, needs, the timely mobilizing of resources, and support and oversight to ensure that the full benefit is delivered from each resource are also required.

The third one is to monitor client progress. The management team can measure progress in terms of specific milestones that reflect the evolution of a new venture as well as the mission of the incubator. Roles of monitoring client progress are to provide focus to both incubatees and incubator actions, thus ensuring that both they attains their goals, and to ensure that the incubatee is committed to launching the venture and graduating from the incubator.

**2) Professional infrastructure**

The pool of professionals supporting a Business Incubator will ultimately influence the incubator's integrity. Professional infrastructure is a combination of three basic resources listed below.

The professional network is a collection of experts from the incubator's region who are willing to provide services to incubatees at no cost or at reduced rates. They are typically consist of professionals such as CPAs, attorneys, venture capitalists, university professors, technology specialists, marketing specialists. A business incubator shall focus on developing pool of individuals who are recognized as experts in particular areas.

The second ones are mentors. Typical mentoring program draw on a pool of experienced entrepreneurs who have been successful with their own ventures and who wish to share this experience with others. The mentoring program can also expand the number of stakeholders interested in supporting the incubator.

The third are advisory boards. Most new ventures lack an effective board of directors during their early stage of development. A Business Incubator may provide such incubatees with a temporary or "shadow" board to serve in this function before a formal board of directors is established. The advisory board can provide clients with an organizational framework for building the business early in the development process. It can also expand the number of stakeholders interested in supporting the incubator.

**3) Capitalization and financing for incubatees**

Since only few new ventures can finance growth from revenue generated from sales, the capitalization and financing for incubatees is always a critical issue for the management of a Business Incubator. The cash flow to a business is like blood to a human body. If everything else is in place, a lack of capital will force even the most promising new ventures to miss

opportunities for competing. Normally, capital can come from equity, debt or some hybrid of the two. Sources of quality capital are normally include individual/corporate investment, venture capitalists, government fund, “angels”, or the incubator. On the other hand, the sources of debt capital may include Capital Networks and Brokers, In-House Capital Funds, Seed Capital Funds, Tenancy-Contingent Financing, Loans from the government, etc. (As in the USA)

**4) The establishment of incubatee networking**

Majority of economists, industrialists, experts, incubator managers, policy makers, and venture capitalists recognize the importance of entrepreneurship in contributing to the development of local wealth as well as competitiveness. On the other hand, “Stand-alone” incubators are considered to be less effective than those integrated into a broader network of incubators, funding and infrastructure providers.

One of the significant benefits of business incubation programs is the synergy that develops from incubatee networking. There are three types of benefits that incubatees realize through their interactions and relationships:

- Psychological benefit represents the moral and psychological support the incubator provides incubatees and incubatees offer to each other.
- Instrumental benefit is related to the work or tasks of operating a business. For examples like sharing equipment, co-bidding and the availability of computers, laboratories and other business and technical resources.
- Developmental benefit involves the process of increasing the firm’s and entrepreneur’s abilities by acquiring skills and generating new ideas.

Gregg Lichtenstein characterizes eight factors that influence incubator interactions as: Types of businesses, Personal characteristics, Stage of development, Space, Forums, Critical mass, Norms and attitudes, and The incubator manager.

**5) The abilities to assist in technology transfer and commercialization**

- **Technology transfer:**
  - Linkage to universities, research institutes, and overseas
  - Mechanism of technology evaluation, licensing, and dealing with other IPR affairs
  - Access to government subsidy R&D projects
  - R&D alliance
- **Technology commercialization**
  - Overcoming cultural impediments
  - Providing financial incentives
  - Developing comprehensive support for commercialization

**6) Academia linkage**

There are only very few incubators in the world obtain full capacity to serve their clients. With proper linkage to external resources, a Business Incubator can easily broaden its services to incubatees with relative low costs. Listed below are some common resources can be obtained by academia linkage:

- Technology transfer
- Access to facilities and equipment for R&D
- Student interns and employees
- Professional consulting in both technology and management fields
- Access to R&D financing (such as the SBIR project)

**7) Basic facilities**

From incubatees' perspective, facilities of an incubator may offer value in image, operational efficiency, responsiveness, and supports from other incubatees. For facility considerations/specifications may vary from case to case, but there are still some items in common. Some are suggested in siting a new facility or evaluating existing ones. They are:

- Zoning
- Building codes
- Location
- Traffic and parking
- Space for lease
- Security
- Insurance
- Access to shared facilities
- Material flow
- Hazards
- Staging areas
- Floor loads
- Telecommunications
- Heating, ventilation, and air conditioning
- Electrical
- Plumbing and sewing system
- Storage
- Shared or common test/production areas
- Flexibility
- Interaction
- Financial sustainability
- Special features and other considerations

**8) Governance and staffing**

Business Incubators must embrace the same standards as their incubatees' strength, tenacity and adaptability of internal leadership and organizational framework. Both should have adequate abilities in raising capital, adapting to changing markets, responding to technology advances, rolling out a product and executing the business model. Here are some issues to be considered:

- Tax Structure:
  - For-profit
  - Not-for-profit organization
- Board of Directors:
  - Legal responsibilities
  - Providing strategic direction and leadership and supporting Incubator Managers in performing their duties (Include individuals with different characteristics and skills)
- Management Team:
  - Incubator Director, Manager
  - Facility Manager
  - Administrative Assistant
  - Receptionist
  - Volunteers from the community

The role of governance and staffing may include:

- Ensures tax status required to meet the organization's agreed-upon mission
- Ensure that both board and management achieve consensus on a mission
- Promotes acquisition of management with the skills necessary to meet the mission and help new ventures grow
- Ensure optimum return on investment on limited but valuable resources
- Promotes retention of quality staff

**9) Incubatee screening and graduation**

To be a successful incubator, it has to be very carefully in selecting incubatees and conducting graduation policy. The screening process shall be customized to meet its mission. We may conclude some criteria in selecting incubatees as innovative ideas, patent protection, product feasibility without undue risk, market niche, technical knowledge and edge, potential to growth, job creation potential, sufficiency of startup funds, community benefits.

When making a graduation policy, at least three criteria shall be considered. The first one is called “Time limits”. They should be customized by type of business and depend on the actual status of incubatees. The second one is “Resource commitments” by the incubator. The last one is “Value affordable by the incubator.” When incubatees have progressed beyond the incubator’s capacity to provide sufficient value, it is time for them to graduate.

**10) Evaluation of incubation program**

For any proper evaluation of incubation program, the process should be manageable in terms of time and resources. Incubation programs should be compared only with others of similar type and mission. To do otherwise is to compare apples and oranges. Listed below are some criteria in evaluating the performance of an incubator for reference.

**General goals:**

- Diversifying local economies
- Revitalizing a distresses neighborhood
- Building/accelerating growth of local industries
- Generating income and benefits for sponsoring entities
- Retaining businesses in the local community
- Encouraging specific entrepreneurship

**Specific goals of technology**:

- Technology commercialization/industrialization
- Increasing employment of high caliber researchers/engineers
- Developing a technology infrastructure for specific industries
- Providing job opportunities for target groups
- Providing real-life learning experiences for college students

*(Revised from:: Chuck Wolfe, Dinah Adkins, Hugh Sherman, “Best Practice in Action”, NBIA 2001)*

For NBIA’s evaluation of the Incubator of the Year, it may be referred to ITRI’s case as mentioned.

## 6.2. Job Distribution

**Board of directors**

The member of the board of directors of a Business Incubator are normally consist of investors, local/community industrial leaders, professors, government officials (if sponsored by the government), professionals (CPA, lawyers, business advisers and others). Each director shall run for the optimum benefits of the Business Incubator by his or her domain knowledge, influences, and linkages to outside resources.

Better networked incubators perform better. Incubators that can provide the incubatees with effective internal networking (such as alliance among incubatees) and sufficient external networking as well (such as technical support from outside experts, professional assistance from outside consultants, support from the central and local governments, etc.).

Encouraging networking among incubatees is an important success factor for incubators.

**Manager & staff**

In a daily incubation practice, it takes a lot of efforts to meet incubatees' needs and wants. Essential practices for a Business Incubator can be divided into four categories as Business Concept, Physical Resources, Core Competencies or Skills, and Market. The following table may be applied to develop/define the incubator manager and staff's practices. Base on the matrix next page, job distribution, workloads of incubator managers and staff can be specified.

**Table 5 Treatment Matrix: Business Incubation Practices Organized by Incubatees' Needs**

| **Entrepreneur Resources**<br><br>**Resource Accessibility Obstacles** | **1. Business Concept** | **2. Physical Resources**<br>Supplies/Raw Materials<br>Office/Lab/Production Space<br>Equipment/Plant<br>Money/Capital | **3. Core Competencies /Skills**<br>Managerial<br>Technical/Operation<br>Marketing & Sales<br>Financial<br>Legal<br>Administrative<br>Higher-Order Skill | **4.Market**<br>Product/Service<br>Customers<br>Distribution Channels<br>Transportation |
|---|---|---|---|---|
| **a. Availability** | | | | |
| **b. Visibility** | | | | |
| **c. Affordability** | | | | |
| **d. Transaction Barriers** | | | | |
| **Entrepreneurial Capacity Obstacles** | | | | |
| **e. Self-Awareness** | | | | |
| **f. Accountability** | | | | |
| **g. Emotions** | | | | |
| **h. Skill** | | | | |
| **i. Creativity** | | | | |

*Source: Gregg A. Linchtenstein & Thomas S. Lyons, 1996*

## 6.3. Personality & Experiences: Put Right Men on the Right Job

Personality is made up the characteristic patterns of thoughts, feelings, and behaviors that make a person unique.

Incubator managers must first be able to diagnose problem by identifying the necessary resources, existing problems and entrepreneurial need, and then know which practices they can employ to help the entrepreneur meet that need. Incubator staff members must be entrepreneurial and non-bureaucratic and recognize that they are in a service industry. Besides to help clients develop management team, they also have to get the mail out on time. They are asked to hold a special relationship with their clients—both leader and servant—and only those types of personalities are appropriate for the staff of a business incubator.

It takes well-experienced staff to operate good business incubators. The staff is always required to be “multi-functional” in serving incubatees. This is not an easy job at all! Putting right men on the right job is a must in any incubator’s operation.

## 6.4. Incentives, Flexibility, and Organizational Culture

**Incentive:**

Limited budgets and a public/not-for-profit sector lead many incubator boards to offer compensation package that are nor competitive with fair market rates for similar experience and skills. But to attract and retain talents to sustain a successful Business Incubator, competitive and benefits packages are necessary. Possible solutions may rely on outside funding and linkage to a bonus pool of investment on incubatees.

**Flexibility:**

Incubators should periodically adjust accordingly to adapt to the constant industrial and environment changes. Furthermore, flexibility and creativity should be honed to generate more business opportunities.

- Subject to environmental changes
- Quick/in time response to clients’ needs
- Service flows
- Need a consensus among the management team
- Authorized by the Board of Directors

**Organizational culture:**

- Being passionate
- Being idealistic
- Being innovative

- Mutual trust
- Be willing to share
- Stress on social responsibility

## 7. Discussion:

### 7.1. Critical Issues for Incubator Development (by each participant)

- Internal
  - Management team & staff
  - Board of directors
  - Space
  - Facilities
  - Finance
- External
  - Economy situation
  - Government finance/budget
  - Competitiveness in the international market
  - Entrepreneurship of the society
  - Requests from nterest groups
- High-tech or simple-tech
- Manufacturing or service

### 7.2. How to Promote Incubator Cooperation among APEC Members

- Information sharing
- Visiting
- Conferences
- Establishment of data/information platform
- Training courses and workshops
- International strategic alliance among incubators
- Internship/staff exchange program

## 8. Case Study/Present

### 8.1. ITRI Incubator (A full copy of the nomination material for NBIA Award 2006)

ITRI Incubator is the owner of “the incubator of the year” by AABI and NBIA in the year of

2005 and 2006 respectively. Since its establishment in 1996, ITRI Incubators has been proven to be an effective policy tool to promote national economic growth by the incubation of high-tech startups.

It is the first incubator in Chinese-Taipei. This case study will present a complete story of policy thinking, resource scanning, management team formation, financial planing, marketing and promotion strategy, resource leveraging, and outlook.

**Incubator name**

ITRI Incubator

Rm.101, Bldg. 53, 195, Sec. 4 Chung Hsing Rd., Chutung, Hsinchu, Taiwan 310

http://incubator.itri.org.tw

http://openlab.itri.org.tw

**Incubator category**

Category 1: ITRI Incubator focuses on nurturing high-tech tenants.

**Incubator's mission**

- To nurture high-tech start-up companies through ITRI total resources
- To assist traditional industry upgrading by ITRI's R&D capabilities

**Year incubation program began accepting clients**

ITRI Incubator began incubation program in 1996.

**Current gross square footage**

Current gross square footage is 14,510 m2 (156,200 ft2).

**Incubator tax status**

ITRI is a not-for-profit R&D institute. ITRI employees have operated its incubator independently, without any government sponsors.

**Incubator accomplishments**

**1) Business development services**

ITRI, Industrial Technology Research Institute, is a not-for-profit R&D institute founded in 1973 with three major functions for creating innovative technology, developing emerging industry and enhancing industrial competitiveness.[1] With an outstanding track record on spin-off high-tech companies, ITRI began to nurture Taiwan's entrepreneurs by operating business incubation in 1996. The ITRI Incubator, the first in Taiwan, operates two kinds of programs, one for nurturing start-up companies (incubation program), and the other for participating in R&D projects with ITRI R&D labs (collaboration program).

■ **Stringent review process**

Following lengthy discussion on technology, business models, team members, finance, and stockholders included in the business plan, Incubator manager makes suggestions to tenants for building a lower risk venture. Simultaneously, Incubator manager seeks to integrate ITRI abounding R&D resources into startup companies to create a win-win situation. The following review committee will decide whether an applicant is qualified for incubation or not, an important mechanism for ITRI Incubator. The committeemen, including an ITRI senior engineer, university professor, sophisticated management consultant, and ITRI's venture capital representative will criticize inexperienced entrepreneurs from many aspects to find the best solution for the deficient business plan. They fulfil Incubator's selection criteria "***NIII***, ***N****ew company with* ***I****nnovative technology will make huge* ***I****mpact on existed industry joining ITRI* ***I****n-house incubation program*" to select prominent incubatees. The tenants will modify further business strategies according to the results of the review committee.

The qualified and budding entrepreneurs get assistance in building a new office and laboratory from ITRI Incubator. The Incubator presents 156,200 square feet of R&D space, complete with physical and chemical characterization abilities, an HVAC system, a broadband-wired system, and well-established emission and wastewater facilities. The tenants can build their own laboratory or sign service contracts with the ITRI R&D Laboratory with Incubator's assistance to develop a prototype. ITRI also creates a comprehensive and suitable environment such as accommodation, business hotel, library, cafeteria, and sports facilities for tenants. It can help tenants focus on R&D activities rather than niggling work.

- **Value-added services for tenants**

Business operations help is continuously provided and disseminated in several forms. ITRI Incubator's on-site management team and consultants, such as lawyers and accountants, ensure that tenants receive quality assistance regarding pertinent issues. With proper instruction provided by Incubator, most tenants developing frontier technology can have a better chance to win the SBIR R&D subsidies. The CEO Club, irregularly held by Incubator, invites experienced management executives for meetings, thus increasing network and cooperative opportunities with strategic partners. The surprising results, which frequently occur, make horizontal alliances between tenants. The mentoring program, or Elite Party consists of our consultants, and offers solutions through interviews and discussion by way of carefully designed focus group meetings. Overseas marketing exploration searches for the right situation for tenants, while strategic alliances with the Acer Group and CETRA (China External Trade Development Council) add intense support to marketing services. The official quarterly "Focus OpenLab" reports tenants' status quo, latest technology trend, managerial issues, and the best practices that have been a powerful tool in marketing for tenants.

For educating technology-oriented entrepreneurs in the business domain, the Incubator launched a series of free training courses, known as the Technology Innovation and

Entrepreneurship Forum (TIEF), for our tenants since 2002. It offers courses in a range of topics, often provided by companies prominent in the field who want to develop connections with young start-ups. For example, the accountancy firm Diwan, Ernst and Young provides forums on how to deal with taxes, and Yuanta Core Pacific Securities offers advice on how to list on the stock market. Other courses tell budding entrepreneurs how to read financial reports, apply for patents, get government grants, and manage employees' time.

- **Incubation with investment function**

The Industrial Technology Investment Corporation (ITIC), owned exclusively by ITRI, is an in-house venture capital fund targeted to seed startups, which visits and reviews clients regularly with Incubator manager.[3] Incubator not only works with ITIC but also helps tenants access other valuable venture capital. The “VICTORY” activity held by ITRI Incubator provides an investment platform to creative dialogue between both venture capital and tenants.

Our international tenants (for example, Telecodia, FESTO, and Corning) are the catalysts to foster internationalization in the ITRI Incubator. Every foreign employee is soon familiar with the ITRI environment and quickly sets up a liaison office with our effort and assistance. To link ITRI abounding R&D capacity with overseas entrepreneurs, ITRI Incubator recently extended its incubation service to North America. Thus ITRI's incubator in Silicon Valley will offer knowledge on how to open a business, technical support and trade consulting services to potential clients, and help them promote the sales of their products to the Asian and Pacific region.

*Note:*

*1. ITRI Website: www.itri.org.tw*

*2. “Focus OpenLab”: http://www.itri.org.tw/eng/about/publication.jsp?tree_idx=0700*

*3. ITIC Website: www.itic.com.tw*

**2) Program results**

- **Overview of tenants**

By integrating different resources into a comprehensive environment, ITRI Incubator attracted a total of 243 firms to garrison. All tenants can be divided into four categories: 1.Incubation Program Tenants 2.Collaboration Program Tenants 3.International Tenants 4.Service Providers. The incubator has more than 13,000 square meters of space for lease, which companies can use for offices or research facilities.

**Table 6 The Categories of Tenants in ITRI Incubator in Sep.2005**

| Categories | Incubation | Collaboration Program | Service | Sum |
|---|---|---|---|---|

| | Program | R&D Companies | International Companies | Provider | (Companies) |
|---|---|---|---|---|---|
| Client | 16 | 25 | 4 | 16 | 61 |
| Graduates | 77 | 98 | 3 | 4 | 182 |
| Total | 93 | 123 | 7 | 20 | 243 |

From the beginning of incubation at ITRI, 134 new start-up companies have been formed with ITRI's assistance. Ninety-three companies have joined the incubation program; others emerged from the collaboration program. These entrepreneurs built new ventures with limited resources at initial stages. The original capital of startups accumulated about US$136 million dollars. After a two-and-half-year-incubation period, tenants doubled their capital raised from investors or ITIC. All tenants attracted US$1.52 billion in investments in nine years.

The work of Incubator creates jobs. Since 1996, tenants in Incubator have employed 6,650 persons. 90 percent of tenant' employees are researchers and technicians, 40 percent have Master's degrees and higher. Many high-tech client firms also provide more benefit and stock options to recruit ITRI's outstanding employees.

As the above table of Incubator Tenants indicates, 182 firms graduated successfully, and over 80 percent of graduates remain in the Hsinchu area. Thirty-five graduate firms received permission to move directly into the Hsinchu Science Park that is the heart of high-tech industry in Taiwan. Twelve new start-up tenant companies went IPO within the last three years. Five tenants showed their gratitude by contributing to Incubator's bottom line, whether by sponsoring activities, donating valuable services, money or equipment. Until now, Incubator has received US$172,000 dollars, service of parametric test solutions, and a set of wireless Internet access points installed around the ITRI campus.

- **Business development services**

Capital raising activities, known as VICTORY (**V**enture **I**nnovation **C**onvention—**T**aiwan **O**n the **R**ise, ***Yes***!), take place periodically to help tenants' fund-raising by cooperating with Monte Jade Science & Technology Association. Most tenants are invited to make a business presentation for interested venture capitals, and some invest. Enova Tech. **2**, graduated in April 2005, got US$3M dollars from venture capital by participating VICTORY. Sometimes the new-product-fair that is combined with VICTORY gets a sound marketing effect. The CEO Club invites experienced management executives for meetings, increasing network and cooperative opportunities with strategic partners. The Mentoring Program offers solutions through interviews and discussion by way of carefully designed focus group meetings.

The ITRI Incubator plays an active role in business education. We invite experienced experts to lecture tenants on management, accounting, finance, etc. These free courses, TIEF, which focus on entrepreneurial training, have lasted for four years. A total of 140 courses have been

conducted, and attendees have reached upwards to 5,500 persons.

■ **Duplication incubation experience**

By documenting key incubation processes from entrepreneur interviews, reviewing processes, and providing graduation services, ITRI Incubator has developed knowledge management of incubating experiences. It enables ITRI to duplicate incubators around the island. A Nankang IC Design Incubator, affiliated with Nankang SoC Park (Taipei, Taiwan), was established in 2003 for nurturing IC design companies.[3] A Southern Taiwan Innovation & Research Park (Tainan, Taiwan) installed the incubator to help entrepreneurs develop new ventures.[4] ITRI Incubator assisted the feasibility study, and the regulation and incubating system of the above two incubators. The two incubators operated by an ITRI employee had been categorized as part of the ITRI incubation system. With the successful accomplishment of incubation in Taiwan, ITRI has begun to extend incubating service to North America. ITRI Incubator, North America, will assist overseas entrepreneurs in venture creation and development by linkage with ITRI's resources.

The ITRI Incubator was just awarded the "AABI Incubator of the Year 2005" in May. The award is presented to ITRI Incubator as the highest score-holder among eight Asian incubators in six major assessment categories -- *the management of the incubator, the range of services, the current state of incubated businesses, results of incubation efforts, financial conditions, and successful graduate businesses*.

*Note:*

*1.VICTORY Website: www.mjtaiwan.org.tw/2005vc/01.htm*
*2.Enova Technology Corp. Website: www.enovatech.net*
*3.Nankang SoC Park Website: www.nspark.org.tw*
*4.Southern Taiwan Innovation & Research Park Website: http://sirdp.org.tw/sirdp/*

**3) Financial stability**

■ **Full commitment from the top**

ITRI is a primary R&D center for industry and its revenue composition is unique. Government partnership provides about half of ITRI's income. The other half comes in the form of research and service contracts from the private sector. This "half-half" situation allows ITRI to pull from a wider variety of resources than either public-only or privatized R&D facilities. Over a decade ago, the government funded ITRI by the Technology Development Project, in the amount of US$ 70M, to construct the Innovation Plaza, which is designed as a multi-function building. Since then, ITRI Incubator has to pay nearly 43 percent of the rent revenue to the government as payment for the use of its building. The total floor space in the Innovation Plaza is 1,504,800 $m^2$, including the space of laboratories, offices,

cafeteria, parking lot and public areas, and most of that is utilized by ITRI Labs. In the beginning of operation, Incubator occupied up to 20 percent of the available labs and offices in this building for nurturing ventures. With the increasing scale of ITRI Labs, ITRI Incubator decreases the operation area which less than 10 percent of the Innovation Plaza space.

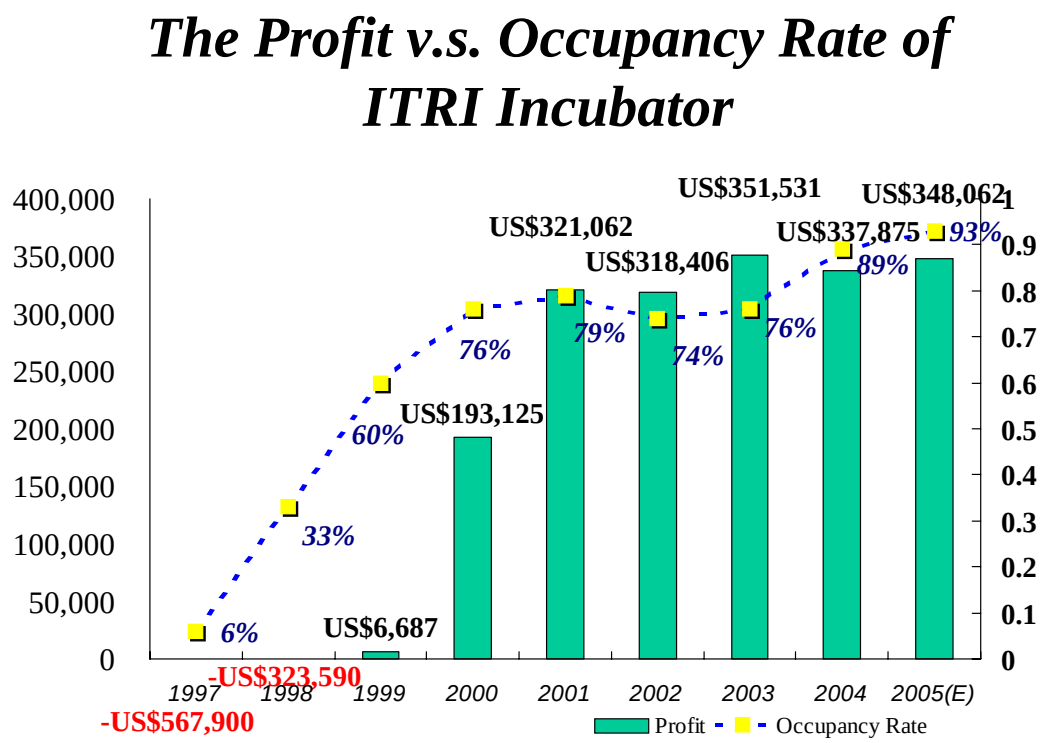
ITRI Incubator was started with high hopes as well as high-level support from ITRI top management. A low occupancy rate was a major reason the ITRI Incubator lost nearly US$1 million dollars in the first two years. Determined to carry on, Incubator management personnel leveraged ITRI's abundant resources to serve tenants. With a full-time crew of just five people, Incubator made a modest (US$6,687) profit without government subsidy in its third year of operation. More satisfied tenants' graduate and more occupancy rate increase. The brand name of ITRI Incubator are forming and attracting the new comers to cause the increment of occupancy rate.

- **The structure of incubator's revenue**

Revenue is derived from several sources. 80 percent of the revenue is from the rent, and the remainder may come from utility charges, accommodation fee, conference room fee, donations, etc. Although incurring a deficit in the first two years, Incubator made a profit the third year. With an increase in occupancy rate, Incubator achieved financial breakeven at the seventh year. In 2004, the revenue of ITRI Incubator reached US$1,445,438 dollars, and US$1,205,195 dollars came from the rent. ITRI Incubator has achieved self-sufficiency that requires no external subsidy to cover operating expenses.

Currently, Incubator benefits from over a 90 percent occupancy rate. The high occupancy rate guarantees cash flow, and offsets the fact that Incubator pays the Government 43% of the rent as payment for the use of Innovation Plaza. The payment has accumulated to US$ 4.25M for nine years. Compared to the initial cost of construction, Incubator keeps the beneficial investment for the government. In 2004, payment to government was US$ 525,313 dollars.

Five tenants spontaneously donated US$172,000 dollars to show gratitude to ITRI's assistance in past years. Contributions to Incubator help make possible new incubating activities and events.




*Source: ITRI Incubator*

**Fig 1 The Profit vs. Occupancy Rate of ITRI Incubator**

■ **Various incomes derived from tenants**

Some tenants seek to cooperate with ITRI R&D departments by collaborating contracts after they meet the problem in new product development. This in itself brings ITRI a steady income.

ITRI reserves the right to hold between 5 - 10 percent of the shares for each start-up company that participates in the incubation program. The Incubator staff plays a vital role in investigative dues of tenants. With careful screening, ITIC has invested over US$15M dollars in nearly thirty incubatees and made profits of US$18M dollars. It shows that the value of new star-up companies has been created through ITRI incubation.

**4) Success stories**

■ **Phison Electronics Corp.** (http://www.phison.com)

Phison, currently ranking No.2 worldwide in flash memory controller providers, reached an EPS of 9.7 last year. Phison was established during November 2000, at the ITRI Incubator. The founders were five young graduate school students excelling in USB flash controller technology and related NAND flash applications. In May 2001, Phison successfully

developed the world's first USB flash removable disk - Pen Drive. Now, Phison has developed into one of the most competitive hi-tech firms in Taiwan.

- Foundation: Nov.2000 at ITRI Incubator
- Incubation Period: Two years
- Core technology: USB flash controller technology and NAND flash related applications
- Employees(2005.5): 155 persons
- Grant & Award
  - Received 3 SBIR subsidies
  - Received top "Gold Medal" award out of nearly 200 companies in Taiwan Incorporation Competition (TIC) organized by the Ministry of Economic Affairs
- IPO: Listing on emerging stock market in 2004
- Revenue: $121M(USD) in 2004
- Donation: Accumulated NT 2.5M to ITRI

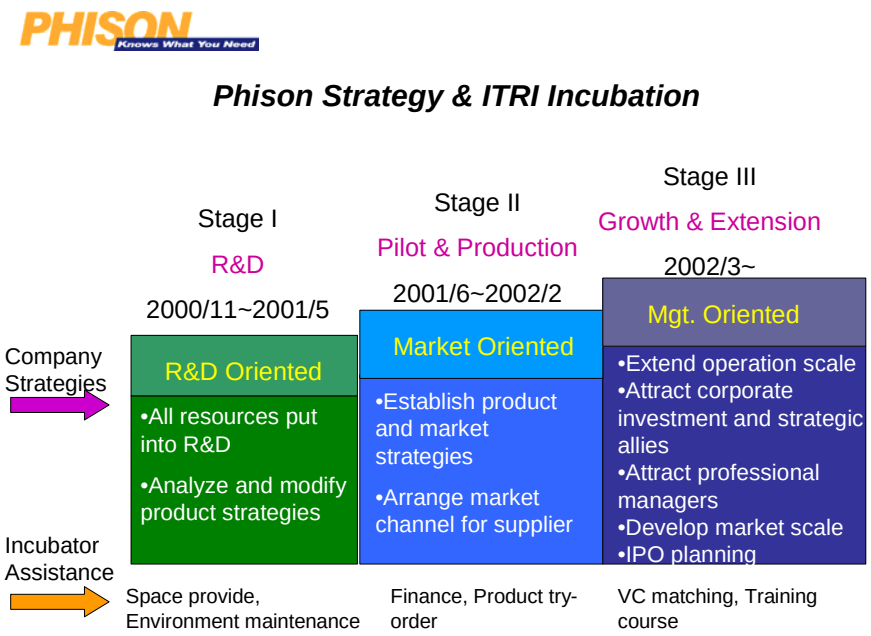



**Fig 2 Phison Strategy & ITRI Incubation**

Source: ITRI Incubator, 2005

During the early marketing stage, Phison's products were heavily promoted by ITRI's industrial networking. The multi-pronged strategy paid off. Fujitsu, Siemens, and ASUSTek have approved Phison's products. The continued orders garnered from these companies have

made for exponential growth. Phison was the champion of the 2002 Taiwan National Innovative Business Award.

- **Prolific Technology Inc.** (http://www.prolific.com.tw/)

Prolific Technology Inc., a leading IC design-house and ASIC design services provider. Established by a highly experienced group of ITRI specialized technical engineers, Prolific entered ITRI's Incubator in August 1998. The CEO, C. T Chang, was ITRI alumnus. He says, "Prolific was nurtured and grew entirely by ITRI's support!" The management team's extensive network of contacts made during their time at ITRI came into play when Prolific was established. In the initial stage of Prolific, Chang's former boss at ITRI facilitated the first order to help overcome the crisis.

According to the outstanding performance of Prolific, they got several awards in recent years, like "*A promising IC design house, ranked as the most competitive fabless company in Taiwan by Merrill Lynch*," "*Ranked as No. 22nd in "Taiwan Technology Top 100" by Business Next Biweekly*," etc.

With continuing cooperation with ITRI Labs to complement their R&D capacity, Prolific grow and development in the platform of incubation. Prolific actively joins CEO Club, Mentor Program, and TIEF training course to reduce learning curve. These are the main assistance that ITRI Incubator provides for Prolific. Prolific donated the sum of NT$2M dollars to ITRI in 2003 and 2004.

Prolific's sale revenue reached US$40.6M dollars last year. For more information about olific's financial report, please access the webpages: *http://www.prolific.com.tw/eng/investors.asp*

**5) Best practices**

- **Utilization of ITRI advantage**

ITRI's own core competence rests with a strong R&D capacity. The advanced technologies owned by each organizational unit can be accessed by Incubator participants. The timely assistance in other areas, such as funding, is a key reason why Incubator participants usually complete their mission in less than two years, and acquire fast access to today's markets. In short, Incubator serves two purposes: technical cultivation and business investment.

Companies that take advantage of joining ITRI Incubator benefit in a unique way. ITRI's resources are augmented by its abilities in capital funding and planning, consultation on legal and intellectual property, accounting and financial advice, personnel training and recruitment, industrial networking, and the leasing of facilities. This integrated business approach covers all aspects of business daily life, and, in doing so, allows companies to focus on their own further development.

■ **Concept of ITRI incubation model**

ITRI Incubator owes many people for its current level of success. The positive practices in place that are the underpinning of the Incubator derive from the concept of **TAM** (Total Asset Management). Indeed, Incubator's utilization of this system gives participating client companies a far-reaching ability to acquire resources. TAM allows client companies to obtain the maximum amount of resources at a minimal cost – a way of thinking and acting that can help any business meet and exceed its potential.

■ **Unique selection criteria**

In addition to operation management, Incubator also promotes two other business principles: **NIII** and **CCC**. NIII is an acronym used to assess the qualifications of Incubator applications: N (newness), I (innovation), I (impact to industry), I (in-house incubation). If a prospective company is new, innovative, has the potential to impact industry, and would benefit from access to Incubator resources, the company is a prime candidate for Incubation Program. CCC functions as a guideline for the operating principles governing the Collaboration Program. Through **C**ollaboration, **C**ommercialization, and **C**ontribution to industry, both Incubator and our participant companies can thrive in this incubator setting. In other words, Incubator works closely with industry to develop and commercialize products and technology with lasting impact.

■ **Striving for the future**

ITRI Incubator has evolved from the ground up in just nine years. In the future, we will constantly strive for new and innovative management models to achieve more challenging goals. Incubator also has a unique "learn by doing" attitude that allows us to adapt to Taiwan's fast-changing business landscape. Five full-time staff serve participant companies by acting as one-stop contact windows. These dedicated managers are liaisons between the companies and ITRI, and provide external resources for our tenants. A dynamic platform for value-added and streamlined services, such as the VICTORY activity and TIEF training courses, serve to add value and make working with Incubator a comprehensive win-win situation. Treating the incubation experience as the result of knowledge management will enable ITRI to export this kind of business to assist those who want to deploy an incubator.

■ **ITRI Incubator**

Income Statement

Jan.1~Dec.31, 2004

| | |
|---|---|
| **Operating Revenue** | **1,445,438** |
| Agency revenue | |

| | |
|---|---|
| Rental | 1,205,195 |
| Utilities charge | 167,493 |
| Accommodations service | 57,757 |
| Internet service | 14,994 |
| Other operating revenue | |
| Governmental funding | 0 |
| **Operating Expenses** | **1,098,188** |
| General & administrative expenses | 572,875 |
| Payroll expense | 88,551 |
| Travelling expense | 4,323 |
| Maintenance | 95,573 |
| Advertisement expense | 46,875 |
| Insurance expense | 12,500 |
| Utilities expense | 33,063 |
| Office supplies | 137,500 |
| Entertainment expense | 6,255 |
| Professional service fees | 46,875 |
| Other general & administrative expense | 101,360 |
| Depreciation of buildings (paid to government) | 525,313 |
| **Net Income before income tax** | **347,250** |
| **Income Tax** | **9,375** |
| **Net Income** | **US$337,875** |

*Notes: 1.US$1 dollar=NT$32 dollars*

*2.The operation of ITRI Incubator has been financial self-sustain since its opening on July 5, 1996.*

*3.The estimated net income of 2005 is US$ 348,063 dollars.*

## 6) Extra information

■ **News clippings**

a. ITRI Incubator to be honored as best incubator in East Asia

ITRI Incubator to be honored as best incubator in East Asia

*Publish Date: 06/10/2005*

*Story Type: Economy;*

*Byline: Graham Norris*

Turning a bright idea into a business used to require a lot of time or very rich parents. Now budding entrepreneurs can get financial and technical help from business incubators, such as the one operated by the Industrial Technology Research Institute's (ITRI) Incubator.

Since it opened in 1996, the incubator has helped hatch more than 130 companies, including 5 that have since gone through initial public offerings. According to ITRI, these high-tech start-ups have created more than 15,000 jobs[1] and their accumulated capital has reached US$1.4 billion. The incubator now even makes a modest profit, after suffering a loss in its first two years of existence.

The incubator's success has been recognized by the Asian Association of Business Incubation (AABI), which will name it the best incubation center in the region at a ceremony in Seoul, South Korea, in August. It beat competitors from eight other regions and countries, including the Hong Kong Science and Technology Parks Corp. and the Shanghai Technology Innovation Center.

"The incubator, based on the 'OpenLab' model and ITRI's considerable resources, has built an impressive record in fostering high-tech companies," said one of the AABI judges. "The incubator offers a wide range of services and, impressively, has achieved self-sufficiency within three years." The ITRI was the first in Taiwan to set up a business incubator after the government began a program to promote the development of small and medium-sized enterprises in 1995. Now there are more than 60 business incubators across the country, the vast majority of which are run by universities.

Even before it opened the incubator, the institute had accumulated a great deal of experience creating companies. United Microelectronics Corp. and Taiwan Semiconductor Manufacturing Co. Ltd., the world's two largest made-to-order chipmakers, were both created in the ITRI.

While research continues to be the main focus of activities at ITRI, business incubation has become an important part of the institute's operations, and the incubator's 16 current tenants occupy two large buildings at ITRI's tranquil campus in Hsinchu County.

To attract talent to this somewhat remote location about an hour's drive from Taipei, the campus offers tennis courts, a kindergarten, a dormitory, a clinic, postal and banking services and a cafeteria that can seat 2,000 at a time. But it is the range of business services and support that is the main attraction for entrepreneurs looking for help in starting a company.

The incubation center has more than 13,000 square meters of leasable space, which companies can use for offices or research facilities. The institute offers a 25 percent discount on rent in the first year of occupancy, falling to 5 percent in the third year. Companies must move out after three years, and many relocate to the nearby Hsinchu Science Park, where they can set up production facilities, which is not possible at ITRI.

As well as providing space for companies to set up research facilities, the incubator allows companies to take advantage of ITRI's 13 research laboratories. Companies can either send their own staff to conduct research in the laboratories, or they can ask the institute to provide researchers.

Developing a product is only half the story, however, and the incubator also goes to great lengths to help companies develop the business skills needed to expand. It offers courses in a range of topics, often provided by companies prominent in the field who want to develop connections with the young start-ups.

For example, the accountancy firm Diwan, Ernst and Young provides forums on how to deal with taxes, and Yuanta Core Pacific Securities offers advice on how to list on the stock market. Other courses tell budding entrepreneurs how to read financial reports, apply for patents, get government grants and manage employees' time. Last year nearly 1,500 people attended 40 courses.

Another key component of building a business is networking, which makes it easier for companies to raise funds, hire qualified people, develop cooperative partnerships and, of course, find customers.

Besides offering access to consultants in the Hsinchu Science Park, the key research facilities of National Chiao Tung University and National Tsinghua University and ITRI's own facilities, the incubator encourages interaction between its tenants and established businesses through seminars with experienced senior executives and management consultants. Moreover an ITRI overseas marketing exploration team helps tenants find opportunities overseas.

To increase the visibility of the entrepreneurs working in its incubator, ITRI holds the Taiwan Incorporation Competition 100 every year. Another key networking event is the "Victory" convention, which is held annually to provide entrepreneurs with ideas on how to develop their businesses. This year more than 700 people attended the convention to hear speeches from venture capitalists and intellectual property rights experts. They also looked at case studies of 45 young companies.

Tenants can also get on-the-spot legal and financial advice and even plane tickets from lawyers, stockbrokers and a travel agent who have set up offices in the incubation center.

The in-house venture capital fund, Industrial Technology Investment Corporation (ITIC), can also provide key assistance in raising funds. In addition to investing in promising companies

that are short of money, the ITIC helps tenants develop business plans to apply for small business innovation and research subsidies from the government. Between 1999 and last year, companies in the incubator received grants worth US$7.7 million to invest in facilities, people and products.

But all this help is not available to just anyone, and the entry requirements are stringent. Companies must have been in existence for less than 18 months, have a capitalization of less than US$2 million and employ fewer than 20 people. The business plan must demonstrate that the products are innovative and will have an impact on existing industries, and must take into account market conditions and potential competition.

One company that met the requirements is Aphelion Communications Inc., which makes mobile wireless technology equipment. It moved into the incubator last June, and within six months had secured a US$190,000 government grant and was named one of the top five best start-up companies by the Small and Medium Enterprise Administration of the Ministry of Economic Affairs.

"If we had not moved in here we wouldn't have known about the competition or the opportunity to apply for subsidies," said Aphelion Chief Executive Officer Gary Chiu.

Aphelion's five founders were attracted by ITRI's research facilities, which they had used occasionally at their former company. The space they rent at the incubator includes offices and a small laboratory, and for more difficult research they use ITRI's facilities. The institute also allows them to deploy their product for testing around the campus.

The company now employs 22 people and released its first product in April, samples of which have been sent to distributors around the world. U.S.-based Sprint is one of the companies testing its product, and Aphelion has begun working on WiMAX--worldwide interoperability of microwave access--technology which will offer wireless broadband communications over large areas.

Chiu said the incubator's staff had helped his company with issues big and small, ranging from finding new sources of capital to working out the best way to provide health checks for the company's employees.

"They want us to get out after two years, but we want to stay as long as possible," Chiu said, adding that the university atmosphere of ITRI's campus would be more attractive to the researchers they want to hire.

Communications companies make up more than a quarter of the companies in the incubator, with others involved in integrated circuits, chemical materials, optoelectronics and biotechnology. After graduation, the survival rate is around 70 percent. Six graduates have been acquired by larger rivals such as Broadcom Corp. and Accton Technology Corp.

Phison joined the incubator in November 2000 and developed the Pen Drive, the world's first

USB flash removable disk. The company is now the world's second-largest maker of flash memory controller devices, has had 40 patents approved and employs around 100 people. Revenues came to more than US$100 million last year.

Phison spokeswoman Bonnie Chiu said ITRI's incubator was particularly helpful in finding sources of investment and providing networking opportunities, which helped the company secure orders from Fujitsu, Siemens and Asustek.

"Without the incubator's help in the early stages, Phison would not have been able to grow smoothly," Chiu said. "It was a new company with no credit, and they helped us find trading credit with a bank. They also introduced us to many important partners to create business opportunities." The company was so appreciative of the help it received that it donated US$48,000 to ITRI when it moved out of the incubator. "Basically, they helped Phison to solve all its problems, just like a babysitter," Chiu said.

*Incubator Note:*
*1: This number means that all start-ups companies indirectly create jobs instead of the number of employee when they garrisoned in Incubator.*

■ **AABI Award**

**ITRI Incubator Centre named as best of its kind in Asia**


The Incubator Centre of the Hsinchu-based Industrial Technology Research Institute (ITRI) has won the annual award of the Asian Association of Business Incubation (AABI), called the AABI Award, for this year, an ITRI official said on May 23.

The ITRI centre is scheduled to be bestowed with the title of the best business incubation facility in the region at an award-presentation ceremony in August in Seoul, South Korea, the official said.

The AABI, founded in 2002, is the Asian branch of the world’s largest business incubation organization – the National Business Incubation Association of the United States, and the largest of its kind in Asia with nine members from nine areas in the region, including Taiwan, South Korea, Japan, Malaysia, Singapore, New Zealand, India, Hong Kong and China.

The AABI Award, the organization’s key annual award activity aimed at promoting regional business incubation, is presented to the highest score-holder in six major assessment categories – the management group of an incubator, the range of services, the current state of

incubated businesses, results of incubation efforts, financial conditions, and successful cases. The ITRI incubator won the award with a total score of 689.7 points.

According to the latest ITRI statistics, the ITRI incubator centre has helped create 133 technology-based businesses since it started operations in 1996.

■ **ITRI sets up incubation center in California**

2005/06/29 20:19:30

New York, June 29 (CNA) Taiwan's Industrial Technology Research

Institute (ITRI) recently opened a talent incubation center in Silicon Valley, California, via its North American base -- ITRI International Inc. -- to offer comprehensive services to people interested in starting a new business. With abundant researchers and brilliant technical services to corporations, ITRI's business incubation center in Hsinchu, northern Taiwan, has been chosen as the best center of its kind in Asia by the Asian Association of Business Incubation (AABI) this year.

ITRI President Johnsee Lee said on his recent visit to the United States that Taiwan can become a springboard for talented people in Silicon Valley to enter the Asian market, and the newly established North American incubation center can help such efforts. ITRI's incubation center in Silicon Valley will offer knowledge on how to open a business, technical support and trade consulting services to potential clients and help them promote the sales of their products to the Asian and Pacific region.

In addition to offering technical support to corporations, the ITRI also badly needs high-tech experts from abroad. ITRI's talent-search program from abroad last year received a warm response, and the organization will continue the program in search of high-tech experts with more than five years' work experience in North America.

To strengthen Taiwan's competitiveness, Lee said he hoped that ITRI International, Inc. can forge cooperative relations with noted U.S. universities, research organizations and corporations. Currently, ITRI has long-term cooperative projects with Rockwell Scientific, Co., Stanford University, the University of California at Los Angeles, Corning and Dow Chemical, and has established strategic alliances with SRI International, UC Berkeley, and Carnegie Mellon University.

In 2004, ITRI successfully introduced 211 U.S. patents related to digital imaging ICs to Taiwan, ushering in an era of digital television, LCD television and the digital imaging industry in Taiwan, and the company will keep securing U.S. patents for Taiwan to upgrade the technical level of the island.

(By Elisa Kao)

Source: http://english.www.gov.tw/index.jsp?action=cna&cnaid=11115

## 8.2. Benchmarking and Application Practice

Please point out:

- What are key success factors of your Business Incubators?
- What can be learned from the case?
- What are possible solutions to cope with the existing difficulties you face?

**Conclusion**

Entrepreneurship and innovation is the locomotive of economic growth, nurturing infinite potential and possibilities. The installation of the entrepreneurship and innovation incubation platform will directly stimulate these activities, helping to internationalize future innovation perspectives and business opportunities. Business Incubators play a significant role in extending the industry chain and upgrading industrial structures. In addition to setting up more Business Incubators and improving the function and quality of services, we must continue to work towards better “innovation,” “speed” and “value,” and strengthen the role of Business Incubators as the pivot of resources. The asset of each Business Incubator of a nation should be integrated according to their different specialties, realize the concept of equal theory and practice, and provide incubation services to SMEs at different stages of their development, from idea conception, innovation to entrepreneurship.

## 9. Reference

Allen, D. N. & R. McCluskey, “Structure, Policy, Service, and Performance in the Business Incubator Industry,” Entrepreneurship : Theory and Practice,15(2) , 1990

ASPA, “Annual Conference Paper, 1998-2006,” Asian Science Park Association

Campbell ,C. & Berge D. & Janus, D & Olsen, K, “Change Agents in the New Economy : Business Incubators and Economic Development,” Report prepares for the Institute of Public affairs, University of Minnesota, Minneapolis, MN., 1988

Hsu, C. W. & Chiang, H. C., “The Government Strategy for the Upgrading of Industrial Technology in Taiwan,” Tecnhovation (21), 2001

Hung, Chien-Tsai & Chang, Wen-Long, “A Comparison Study of the Nurturing Services Demand between Tenants and Incubators at Taiwan‘s Incubator Industry,” 2001 Annual Meeting of the Northeast Region of Decision Science Institute, 2001

Erlewine, Meredith & Gerl, Ellen, “A Comprehensive Guide to Business Incubation”, 2nd edition, NBIA

Fiedler, Heinz, “Technology Business Incubation: Facilitating Cooperation”, the 3rd APEC Forum on Business Incubation, 2005

Hung, Chien-Tsai, “Experimental Study on the Performance Model for Taiwan's Incubation Centers,” NEDSI 2005

ITRI, “Annual Reports, 1995-2006,” Industrial Technology Research Institute

ITRI, “Industrial services Databank,” Industrial Technology Research Institute

Lalkaka, Rustam, “Business Incubator as a Means to Small Enterprise Creation and Growth,” International Small Business Congress, 1994

Lia, Robet S. Q., “Business Incubation in the New Century: Strategy, Policy, and International Cooperation,” APEC Incubator Forum Summary Report, The First APEC Incubator Forum , 2003

Lichtenstein, Gregg & Lyons, Thomas, “Incubating New Enterprises—A Guide to Successful Practice,” The Aspen Institute, Rural Economic Policy Program, 1996

Mian, S. A., “Assessing and Managing the University Technology Business Incubator: Integrative Framework,” Journal of Business Venturing (12), 1997

MOEA, “Project Management Databank,” Ministry of Economic Affairs, Chinese-Taipei

NBIA, “10th Anniversary Survey of Business Incubations 1985-1995: A Decade of Success,” NBIA: Athens, Ohio, 1995

Ove, G., “Towards a Theory of the Technology-based Firm,” Research Policy (27), 1998

Sheu, rern-jier, “OpenLab/Incubator Managerial Diary,” Industrial Technology Research Institute, 1995-2005

SMEA, “The Yearbook of Incubators,” Chinese Taipei, 2006

Smilor, Raymond W., “Managing the Incubator System: Critical Success Factors to Accelerate New Company Development,” IEEE Transactions on Engineering Management, 34(3), August 1987

Wen,Chao-tung, “Value Added of incubator to the new technological Startup,” 2000 International Conference on Small Business Incubation & Technology Transfer, by YUT & USI, 2000

# Chapter 4. Research and Business Development

Kyung Suk Han[1]

This course presents the concept of R&BD, SBIR (Small Business Innovation Research) of the United States, BUNT (Business Development using New Technology) program of Norway, R&BD instances of Korea and the method for a small and medium enterprise to touch upon the sustainable success. Since R&BD (Research and Business Development) is the concept that R&D is combined with marketing, R&BD is called the 4th generation R&D (William L. Miller & Langdon Morris). Ushering new era of competition, a new approach is needed to successfully implement innovation and R&D, which is the fourth generation R&D, to cope with the new challenges.

## 1. Introduction

This course presents the concept of R&BD (Research and Business Development) that is next generation R&D strategy that focuses on business-related R&D to provide sustainable benefits for SMEs (Small and Medium Enterprises). In the R&BD program SMEs consider the business or marketing strategy from the early stage of R&D. This course also introduces R&BD programs including SBIR (Small Business Innovation Research) program of the United States, SBRI (Small Business Research Initiative) program of United Kingdom, SBDC (Small Business Development Center) program of each State in USA, BUNT (Business Development using New Technology) program of Norway and R&BD instances of Korea. Eventually it will discuss the methods for a small and medium enterprise to touch upon the sustainable success.

Since R&BD is the concept that R&D is combined with marketing, R&BD is called the 4$^{th}$ generation R&D (William L. Miller & Langdon Morris). Ushering new era of competition, a new approach is needed to successfully implement innovation and R&D which is the fourth generation R&D to cope with the challenge of sustainable businesses. The most important objective of this course is to make innovation-oriented SMEs sustainable with the sufficient amount of profit and to help them establish the business-oriented strategy from the early stage of R&D. R&BD is a critical part for SMEs' development in the APEC member economies.

### 1.1. What is R&BD?

What is R&BD program? R&BD program is next generation R&D strategy that focuses on

[1] Professor, Soongsil University, Seoul, Korea

business-oriented R&D from the early stage of R&D to provide sustainable profits for SMEs. It is considered as good strategy for SMEs to obtain funds from financial institutes including venture capitals. R&BD links R&D with marketing and other business function, which means that marketing and commercialization will be considered from the planning stage and new business will be developed accordingly.

As the R&D cycle is getting faster, R&BD (Research & Business Development), research undertaken with commercialization in mind from its planning stage, is now coming to the fore. In addition to this, high-speed networking and cutting-edge research infrastructure such as supercomputers that can deal with high capacity information rapidly have become very important. In R&BD, the process of commercialization of technology becomes the most important process among establishment of corporation, development of products, manufacturing, and logistics.

R&BD activities are about how the innovative product can meet the market needs and create competitive advantage for those enterprises who implement R&BD program. Through R&BD program, SMEs can have knowledge about creating and providing opportunity for their R&D capabilities by starting a new technology to increase the size of the market and exploit the new market opportunity. R&BD is also expected to increase the enterprise's productivity and increase the product quality which may impact the increase of GDP and good quality of life. Without R&BD, it is very difficult for Small and Business Enterprises (SMEs) to survive in the business competition for a long-term.

## 1.2. Related Theories, R&BD Programs and Policies at a Glance

Most well-known R&BD programs include SBIR (Small Business Innovation Research) Program of the United States, SBRI (Small Business Research Initiative) program of United Kingdom, SBDC (Small Business Development Center) program of each State in USA, BUNT (Business Development using New Technology) program of Norway and R&BD programs in Korea. Main goal of those governmental policies is to provide sustainable benefits for SMEs while helping SMEs consider the business or marketing strategy from the early stage of R&D.

SBRI (Small Business Research Initiative) is designed to help Small and Medium Enterprises (SMEs) gain greater access to publicly funded Research and Development (R&D) contracts. SBDC (Small Business Development Center) also has each purpose in each State in USA, for example SBDC in The Wharton School, University of Pennsylvania, usually called WSBDC (Wharton Small Business Development Center). The WSBDC provides free consulting services to entrepreneurs as well as educational workshops for which we charge a nominal fee. The WSBDC is strongly committed to help small businesses in Philadelphia area.

In Small Business Economics, the SBIR program was created by the Small Business Innovation Development Act of 1982 (Small Business Economics, 2003, Vol.20, Iss.2, page 137-151). The Act mandated that each Federal agency with an extramural R&D budget in excess of $100 million designate a certain percentage of this budget for awards to small businesses. The set-aside was initially set at 0.2 percent of an agency's extramural R&D budget, with a legislated growth to 1.25 percent in 1987. This level continued through 1992. On October 28, 1992, the program was reauthorized through FY 2000 and Congress maintained the growth in the set-aside by directing that the percentage increase to 2.5 percent by FY 1997 and stay at that level through FY 2000. In December 2000, Congress reauthorized the SBIR program through 2008, with the set-aside percentage to remain at 2.5 percent throughout the period. Under the program criteria, ten Federal agencies must currently participate in the program. Total obligations for the program in 1999 were about $1.1 billion.

The program was established with a three-phase structure that promotes progress towards commercialization:

- Phase I awards of up to $100,000 are funded for six months for research projects to evaluate the scientific and technical merit and feasibility of an idea, and to enable the funding agency to assess the quality of the recipient firm and its project.
- Phase II funding is provided for the Phase I projects with the most potential to further develop the proposed idea. Phase II funding is for one or two years, and most awards are $750,000 or less.
- Phase III is when commercialization takes place, when private sector investment and support brings an innovation to market. Phase III may also involve follow-up production contracts issued by a Federal agency. SBIR funds are not used for Phase III activities.

The broad purpose of the program, as stated in the 1982 Act, is to strengthen the role of the small, innovative firms in federally funded research and development, and to utilize Federal research and development as a base for technological innovation to meet agency needs and to contribute to the growth and strength of the Nation's economy. The legislation listed the following more specific purposes:

- To stimulate technological innovation;
- To use small business to meet Federal research and development needs;
- To foster and encourage participation by minority and disadvantaged persons in technological innovation; and
- To increase private sector commercialization of innovations derived from Federal research and development.

These goals have been maintained throughout the program. The 1992 SBIR reauthorization bill placed added emphasis on the commercialization objective and made more explicit the objective of increasing the small business share of federally funded R&D. The 2000 reauthorization does not alter these main objectives of the program. A unique feature of the SBIR program is the fact that it embraces the multiple goals listed above and that it maintains an administrative flexibility that allows very different federal agencies to use the program to meet their needs. While this complexity has been a key to the success of the program, it has also led to misunderstandings about the program. The following discussion is intended to help clarify the program's goals, mechanisms, and rationale (Small Business Economics, 2003, Vol.20, Iss.2, page 137-151).

SBA faces several important administrative challenges to continued improvement of the SBIR program. The SBA's Office of Technology is currently working on improvements in the following areas:

- Improving program monitoring and evaluation. SBA's Office of Technology is developing an on-line reporting system for the SBIR and STTR programs that will utilize Tech-Net - a web-based system linking small technology businesses with Federal technology program opportunities. The new on-line system is designed to collect essential commercialization and other impact data, and to minimize the reporting burden on participating firms.
- Preparing awardees for commercialization. New mechanisms for providing assistance to awardees and other applicants are being explored. These include training or referrals and means of providing SBICs and other venture and angel capital funds with up-to-date information on SBIR firms seeking Phase III financing.
- Providing federal seed funding for commercialization. The SBA is assessing a prospective pilot SBIR Phase III seed capital program to provide funding and support training and assistance for SBIR firms.
- Expanding outreach assistance. The SBA's Office of Technology is administering the new Federal and State Technology Partnership program, supports full financing of current outreach grants to States, and is promoting greater support for partnering.

Also in Small Business Economics, public policy towards business has gradually shifted from viewing the role of SMEs through the static lens towards the dynamic framework (Small Business Economics, 2003, Vol.20, Iss.2, page 129-135). For example, the United States Congress enacted the Small Business Innovation Research (SBIR) program in the early 1980s as a response to the loss of American competitiveness in global markets. Congress mandated each federal agency with allocating around four percent of its annual budget to funding innovative small firms as a mechanism for restoring American international competitiveness.

The SBIR provides a mandate to the major R&D agencies in the United States to allocate a share of the research budget to innovative small firms. Last year the SBIR program amounted to around $1.2 billion. The SBIR consists of three phases. Phase I is oriented towards determining the scientific and technical merit along with the feasibility of a proposed research idea. A Phase I award provides an opportunity for a small business to establish the feasibility and technical merit of a proposed innovation. The duration of the award is six months and can not exceed $70,000. Phase II extends the technological idea and emphasizes commercialization. A Phase II Award is granted to only the most promising of the Phase I projects based on scientific/technical merit, the expected value to the funding agency, company capability and commercial potential. The duration of the award is a maximum of 24 months and generally does not exceed $600,000. Approximately 40 percent of the Phase I Awards continue on to Phase II. Phase III involves additional private funding for the commercial application of a technology. A Phase III Award is for the infusion and use of a product into the commercial market. Private sector investment, in various forms, is typically present in Phase III.

Under the Small Business Research and Development Enhancement Act of 1992, funding in Phase I was increased to $100,000, and in Phase II to $750,000. The SBIR was an offshoot of the Small Business Investment Company (SBIC) program, which provided more than $3 billion to young firms between 1958 and 1969. During this period this amounted to more than three times the total amount of private venture capital. The SBIR represents about 60 percent of all public SME finance programs. Taken together, the public SME finance is about two-thirds as large as private venture capital. In 1995, the sum of equity financing provided through and guaranteed by public programs financing SMEs was $2.4 billion, which amounted to more than 60 percent of the total funding disbursed by traditional venture funds in that year. Equally as important, the emphasis on SBIR and most public funds is on early stage finance, which is generally ignored by private venture capital. Some of the most innovative American companies received early stage finance from SBIR, including Apple Computer, Chiron, Compaq and Intel. Through the Small Business Innovation Research (SBIR) program, the National Institutes of Health (NIH) awarded $266 million in grants to small firms for medical and biopharmaceutical research. It is expected that the SBIR program at NIH will exceed $300 million in 1999. In addition to the NIH, the United States Department of Defense also uses the SBIR program to fund biotechnology firms. Between 1983 and 1997 there was more than $240 million in SBIR awards for biotechnology companies from the Department of Defense. Phase I accounted for $47 million and Phase II accounted for $194 million (Wessner, 2001).

To evaluate the impact of the SBIR on the commercial activities of SMEs, a large, comprehensive survey was undertaken by the U.S. National Academy's division on Science,

Technology, and Economic Policy (STEP) (Wessner, 2001). In addition, case studies were undertaken on the basis of detailed interviews with the founders, owners and employees of over fifty firms (Scott, 2001; Link, 2001; Link and Scott; 2001). All of the case study firms had received SBIR assistance. They are dispersed across the United States and span a broad range of technologies, products and industries. While some are new startups, others have a proven track record of success. These case studies examined the impact of the SBIR in a broad context. In particular, the results from evaluating the SBIR suggested that the benefit of the SBIR extends beyond the impact on the individual recipient firm. The social rate of return, which incorporates this external positive impact, exceeds the positive rate of return. There was no evidence of a negative rate of return associated with the SBIR. There is compelling evidence that the SBIR program has had a positive impact on developing the U.S. biotechnology industry (Small Business Economics, 2003, Vol.20, Iss.2, page 129-135). The benefits have been documented as:

- The survival and growth rates of SBIR recipients have exceeded those of firms not receiving SBIR funding (Lerner and Kegler, 2001)
- The SBIR induces scientists involved in research to change their career path. By applying the scientific knowledge to commercialization, these scientists shift their career trajectories away from basic research towards entrepreneurship (Feldman, 2001 and Audretsch et al., 2001).
- The SBIR awards provide a source of funding for scientists to launch start-up firms that otherwise would not have had access to alternative sources of funding.
- SBIR awards have a powerful demonstration effect. Scientists commercializing research results by starting companies induce colleagues to consider applications and the commercial potential of their own research.

In Research Technology Management, success in technology development depends increasingly on speed to profitable commercialization. This calls for a new type of technology development management (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26). As projects move from opportunity creation through market entry through commercial takeoff, the technology manager needs to perform nine integrative roles at three distinct levels: the venture level, where the business-building is taking place; the championing level, where resources are secured in the internal competition for staff and funds; and the heat-shielding level, where the issues of project legitimacy are resolved. The nine roles range from creating options to keeping venture teams focused.

Competitive success today demands business-building programs in which technologies generated in the lab are rapidly converted into deployable capabilities and speedily commercialized and diffused into new markets. The leader of a technology development

program, therefore, needs to assume a much more comprehensive and integrative role than the traditional R&D manager. No longer can technology be developed in silos in which R hands off to D and D hands off to market development, which in turn hands off to business development. Instead, companies need innovation programs focused on moving an evolving technology through the commercialization cycle as a continuous chain of interrelated processes. In this study, we describe an approach to technology development that focuses not so much on developing technology as on business-building, which connects technology creation to the market. For example, consider how Aventis approaches linking technology and markets. Its executives start by seeking to identify unmet medical needs. Then they focus on opportunities that are scientifically and technologically feasible. They have replaced traditional R&D with a three-phased development approach that focuses their discovery and development efforts on drugs that will have a competitive label and are therefore differentiated from those currently in the market. The unit of action is no longer the scientist within a silo, but a team comprising multiple disciplines. The focus is on the patient, not the technology.

Companies that manage to create a successful business-building program develop a set of relatively simple, but consistent, management processes that cover the entire life cycle of activities associated with the new business start-up: from concept to market entry to business takeoff. When these processes are either not handled or mishandled, we observed progress to be slowed. When processes were missing, business-building efforts often failed. The successful management processes that we have observed are integrated and drive growth through the three stages listed in Table 1. For the sake of keeping our discussion focused, we describe these stages sequentially, but stress that they often do not unfold in an orderly, linear way and that a thriving business-building program would have different activities at each stage:

- Identification and screening of opportunities.
- Introduction of fruitful opportunities into the market.
- Managing the takeoff of the businesses.

The first set of activities involves processes that create an opportunity pipeline, or register-like an inventory of potential opportunities. A successful business-building program requires a large inventory of potential opportunities and a process by which to select a few excellent ones for market launch. Crucial activities here involve creating the conditions for the discovery and recognition of opportunities, together with a disciplined screening process that winnows them for investment in development. Among technology-intensive companies, this is often the process through which ideas from the technology development arena are introduced to business development managers for possible development, or through which problems in

the marketplace are posed to the technologists to identify a solution (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

The next set of activities, which we refer to as market entry activities, involve offering new technologies and business concepts to the market. Sometimes, this exposure is experimental, intended primarily to find out what the real and appropriate applications might be. Sometimes, this is a more aggressive and direct business launch, intended to create a substantial new business. In either case, a crucial challenge is managing learning-learning about the market and learning how the firm's offerings perform for that market. Following market entry, the third set of activities involves investing in and growing those opportunities that are gaining traction in the market. These activities require significant attention to timing and patterns of investment. Recognizing when growth should be aggressive and when it can be brought forward more slowly is a key skill here. Given multiple opportunities, the focus is also a key factor, otherwise a program may over-extend managers' energy and resources, diluting their ability to make a substantial impact in any one arena.

**Table 1 Nine Processes for Sustaining a Healthy Business-Building Program**

| Level | Opportunity pipeline | Market Entry | Takeoff |
|---|---|---|---|
| Venture | Create options | Redefine : launch and experiment | Cope and build routines |
| Champion | Select and screen | Mesh venture and firms need | Redirect resources |
| Heat-shield | Create climate | Path clearing | Maintain focus |

There are three levels and nine roles to concern, within each of these sets of activities, different individuals within the organization assume different roles, which partially reflect the level of action of the role. Depending on the company, a single person can take on more than one of these roles, but for explicative purposes we break these roles into three different levels of challenge: Venturing, Championing and Heat-shielding. At the Venturing level, people's primary jobs involve those tasks that are needed to do the entrepreneurial work of building new businesses. These people have the job of finding out what customers need and how the company might address those needs profitably. Their goal here is to form a set of stable transactions between the new entity and customers, suppliers, distributors, employees, and others necessary to forming the new business.

The Championing level of a business-building program involves a set of tasks having to do with making sure the emerging new business is not damaged by other parts of the firm. At this level, resources must be allocated to new business development, plans must be established and monitored, rewards determined, and the often political and informal process of supporting

new businesses carried out. At the heat-shielding level, a different set of tasks becomes important. Here, goals are broader. A key task at this level is the establishment of what we call a ballpark, or overall framework, for determining which types of new ventures are desirable and undesirable. A climate that encourages new business development is created and led, and processes that ensure external and internal support for ventures are established. At this level as well, major resource allocations are determined. In addition, this level of the program establishes company-wide cultural norms, such as how failures are handled, and what gets prioritized. Combining the three levels with the three stages of activities yields nine roles associated with a healthy business-building program (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

In creating opportunity pipelines program, effective business-building companies are characterized by widespread enthusiasm for identifying opportunities and making them happen, as well as widespread understanding of what to do with a bright idea once it has been articulated. For the heat-shielding challenges level, there is climate creation role that creating an innovation-friendly climate poses two challenges. The first is to heat-shield by establishing a climate of positive acceptance for the legitimacy of your program throughout the rest of the organization. You need to demonstrate to the players in your company that the firm as a whole is committed to business-building. The second climate-creation challenge is to delineate a powerful, compelling and coherent direction for your business-building program to follow and build commitment in your technology program to follow it.

In create organizational legitimacy, particularly in organizations in which business-building has been an on-again/ off-again endeavor, people will understandably look for evidence that this time around there is firm-wide commitment to business-building. Otherwise why should they bother? "This too shall pass-I'm going to stick to my silo." And people in the rest of the organization will view your efforts to create a business-building program with attitudes ranging from skepticism about its usefulness to the firm to active resentment at the resources you are usurping, which they feel they could legitimately employ in the existing business. In creation of legitimacy involves two sets of actions, the first is securing commitment from senior management that they mean it with business-building. We discuss the form of this commitment below. The second is to develop with senior management a coherent and compelling direction by specifying a convincing ballpark for your innovation activity.

In create a ballpark, while it is important to encourage plenty of innovative ideas, it is also essential to have an overall coherence to your innovative activity. People need to know what type of innovations to pursue. For an innovation program to be coherent and directed, the technology development manager needs to establish what we call a "ballpark" or directive framework specifying the types of arenas in which the firm seeks to compete. You, as

technology development manager, will be asked to strike a balance between encouraging great variety and many opportunities and the need for an underlying coherence that will allow your firm to develop deep capabilities that can be deployed to maximum effect. We call this difficult task, specifying the innovative ballpark-delineating a large arena in which to pursue many types of innovation, while at the same time delineating limits beyond which people should not be seeking opportunities that don't fit the firm's strategy and capabilities (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

Consider 3M, respected as one of the exemplars of innovation. When Jim McNerney took over in 2000, 3M was struggling to build profitable growth while coping with an array of 60,000 products, creating huge problems for operational efficiencies and drags on the balance sheet and return on investment. McNerney and his senior managers have been wrestling with the articulation of a new ballpark. At the corporate level, he has articulated a high-level ballpark that is designed to drive growth in profits by delineating the large array of businesses into three types: mature diversified businesses that will grow profits by creating scale, growth-potential businesses that will grow profits by innovative organic growth and premier technology businesses that will grow by business development. Although these are still early days for the strategy, 3M's people seem to be responding favorably, as is the investor community.

In create commitment, specification of a directive ballpark is a powerful organizer of a company's innovation direction. The technology development manager also needs to provide impetus to that direction. This means demonstrating sustained commitment to pursuit of the ballpark. To create a business-building climate you need evidence of commitment from senior management and you need to display commitment to the people who depend on you. Hard evidence of commitment is easy to detect by the people who report to you; it comes from positive answers to the following questions:

- Is business-building a priority item on the senior management's agenda? On your personal agenda? Or is the real emphasis on short-term results? Not just once or twice, but at every meeting, week in and week out, month in and month out? If business-building is not a recurring high-priority agenda item, people are likely to assume that it isn't all that important to you and turn their attention back to the lab bench or to other, easier things (often with a sigh of relief!).
- Are requested business-building initiatives receiving care and attention disproportionate to their small size? If you and your senior executives pay the most attention only to those initiatives that are well developed, people will read this as a lack of genuine interest in newer ventures. Just as babies need more attention in their early years, so too do new businesses demand more, relative to their size, than

grown-up ones.

- Do the business-building ventures get the resources that they need-or does the funding always go to the established business when resources are tight? Are the best people allocated to business-building initiatives? If the business-building group becomes the purgatory from which people's careers never return, good people will quickly figure out that they should avoid such initiatives like the plague.

Your ability to get agenda, attention, resources, and staff when needed is an important heat-shielding function that not only secures the necessary resources, but also builds legitimacy in the eyes of the rest of the firm and the commitment of your people to join the battle to build. It is important to recognize that this commitment is not made with impunity. Whatever resources your business-building projects get are diverted from the ongoing business. If the base business is not healthy enough to sustain its activities without being weakened by resources going into innovation, it is highly unlikely that innovation alone will be sufficient for organizational renewal. Making the choice to divert such resources is a decision with considerable potential impact. One lesson is that the time to start a business-building initiative is when the base business is healthy and generating solid cash flows, not when it has already begun to falter (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

For the championing challenges level, in "Tough-love" selection role the ballpark's, somewhat generic specification needs to be translated at the championing level into decisions about whether to select and allocate resources to specific projects. The processes by which this is done are critical contributors to the success of a business-building program. In successful companies, the presence of uncertainty is recognized. This is quite a contrast from companies in which all management resource allocation processes (such as budgeting and planning) are done in the same way, using the same process irrespective of the uncertainty. The logic is simple: when a business is fairly predictable, one can comfortably use conventional heuristics, such as management by exception for monitoring, and discounted cash flow for valuation. When a business is unpredictable by virtue of its novelty or uncertainty, disciplines that recognize that uncertainty are far more beneficial. Although this would seem like sheer common sense, we continue to be astonished by the tendency of companies to apply "one size fits all" management to both established businesses and new ventures.

The first difference between conventional project selection and selection of projects under uncertainty is that the latter are best thought of as "real options". Real options reasoning suggests that you make low-cost investments with substantial future upside, but that you are also preserving the right to discontinue the investment should certain assumptions not be validated. Among the best practices in this area are spending your imagination instead of money by assembling a staged, incremental investment plan, releasing each subsequent

funding only after the previous one has delivered knowledge to justify further investment. The theory here is that the smaller each incremental investment is, the less you stand to lose in the event that things don't work out. With real options reasoning you concern yourself far more with how to keep failure costs low than with how many failures you have. After all, you can afford hundreds of failures if each of them is inexpensive. Using such real options reasoning is a mindset that you can easily bring to highly uncertain ventures, since most of their value lays in the future opportunities they open up (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

The ballpark specifies what kinds of ventures are desirable. At the championing level, the characteristics of the venture should be made very clear. Among the approaches we have observed to work well are disseminating screening statements, consisting of widely disseminated criteria that will be used to evaluate ideas. The more clear and widely disseminated these screens, the more they help everyone to make intelligent choices about which opportunities to pursue, ideally resulting in both a more focused search for new opportunities and an ability to self-screen. We like to look at screens in two passes: first, a process through which screening-out occurs-those criteria that disqualify a venture completely if they are not met. Next, we look at criteria that suggest venture attractiveness as they accumulate. So the "screen-out" criteria are go/no-go while the screen-in criteria are cumulative.

At DuPont, for example, venture teams we are working with have adopted a variation on this idea, specifying first "no-go" criteria in their screening process, then providing guidance as to what they call "where and how" growth should be built. The DuPont groups have incorporated these principles in scoring documents, which help make the criteria explicit so that they are well understood, and so that different projects can be examined in a consistent manner. The DuPont scorecards draw on Six Sigma technology, making a clear distinction between extremely attractive and less attractive opportunities. Table 2 is an example of such a scorecard. Note that it is not the scorecard that is the magic; rather, it is the thought process lying behind it, the discussion of ventures' features that it precipitates and its consistent use that creates results.

Finally, although it is in theory a great idea to develop screening criteria so that everyone understands which ventures are desirable and which are not, an uncomfortable part of this job is informing those proposing or otherwise involved with a new project that it has fallen short of a screen. The wrong way to communicate these decisions is through a subordinate, a phone call or (worst of all) some impersonal medium like email. What is needed here is evidence of a careful, but rapid decision process, coupled with detailed feedback to facilitate learning in the organization. If ideas are rejected, a champion should always explain why and demonstrate

the logic. It is a way of helping the whole organization learns how to pursue better, more strategic, opportunities.

For the venturing challenges level, in running launches and creating options role, the main activity in the opportunity pipeline space consists of creating options for further business development. Contrary to many popular business publications, finding opportunities is seldom the problem. Quite the contrary-for many companies, the real challenge is capturing the ideas in some systematic way, sorting them into different categories with respect to whether and when they might be pursued, and creating the process through which they receive assessment and attention. Ironically, one of the most important challenges you can face at the venturing level consists of recognizing the uncertainties intimidating your team and reducing their impact. Some call this "absorbing" uncertainty. If you are running a venture, you need to be telling your people what to focus on and what to ignore, which you can do only by essentially creating an artificial feeling of certainty when in fact you are still dealing with many assumptions (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

Sometimes this requires a bit of bravado, for instance when Steve Jobs of Apple declares a particularly uncertain new venture to be an "insanely awesome" product that everyone can throw their weight behind. Sometimes it is more mundane, as when the leaders behind P&G's Spinbrush electric toothbrush venture declared that the target competition for their electric toothbrushes was a $5 conventional brush, rather than the $50 versions then dominating the electric brush market. In either case, the job of a venture leader who wishes to free the team from the paralyzing effects of uncertainty is to create a confidence that the cost of failing or being wrong will not fall on them.

Options thinking have implications for the quantity of ideas to be considered. That's because the whole concept behind options is to skew the distribution of potential outcomes-limiting the downside risk while uncertainty is still high, and making sure that the potential upside is substantial. One implication is that at the opportunity development stage, you want to be able to consider many options-many more, in fact, than you could possibly develop given your resources. The concept at the venturing stage is to pursue many ideas, recognizing that most of them will be discarded or redirected as resource commitments to them become more substantial. Think of this as a funnel, with many ideas at the beginning that will be narrowed down to a few very robust ideas over time. 3M's McNerney has used this idea as a cornerstone of his organic growth strategy, pushing the company to deliver what he calls 2x/3x performance in venturing-twice the number of ideas considered, three times the number pushed through to development. At the venture level, this translates into operationally considering many opportunities.

**Table 2 Scored for Evaluating and Screening Opportunities (Conditions in each cell decide the score to put in the last Colums, and the total score of all the colums is used for comparisons with the scores of alternatives project**

| Dimension | Exceptional | Acceptable | Unfavorable | Score |
|---|---|---|---|---|
| Strategic intent | If this opportunity takes us exactly where we want to go in term of our strategy, score it a 9. | If this opportunity is not inconsistent with our strategy, but offers no engine to drive it, score it a 3. | If this opportunity, even if we can succeed, is inconsistent with our strategy, score it a 1. | |
| Build competitive advantage | If the idea builds both short-term revenue streams and long-term competitive advantage, score it a 9. | If the idea has either long-or short-term benefits, but not both, score it a 3. | If the idea provides only short-term benefits, and may interfere with a long-term opportunity, score it a 1. | |
| Build knowledge capabilities | If the opportunity will help us enhance our capabilities significantly, score it a 9. | If the opportunity will let us build new capabilities, but only in very limited areas, score it a 3. | If the opportunity will not lead us to extend our capabilities in any meaningful way, score it a 1. | |
| Use of existing assets | If the opportunity requires no investment in new assets, score it a 9. | If the opportunity does required some investment but takes advantage of assets in place, score it a 3. | If the opportunity will require entirely new investment in assets, score it a 1. | |
| | | | Total Score | |

In market entry program, very few projects work out exactly as expected. Most of the time, you won't really know what customers are looking for until you receive their feedback. Moreover, even the customers often don't know what they want until they have experienced an offering. The uncertainty of this process creates challenges. The goal in the market entry stage is for the company to engage in continuous experimentation to convert assumptions into knowledge at the lowest possible cost. Key objectives are learning and redirecting while uncertainty is still high (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

For the heat-shielding challenges level, in path clearing role, there is a typical high-tech opportunity usually has some potential to upset an existing status quo (otherwise why bother with it?). This potential for upset can create widespread perception of risk among potential

customers, perceptions of threat from those whose jobs might be changed as a consequence of a venture's possible success, wariness on the part of potential supply chain partners, and so on. Overcoming the risk-averting resistance to a new venture's success is a critical heat-shielding challenge you may have to address, and your obligation as the technology development manager may be to clear the path of resistance via support of senior managers, lest your team's venture stumbles in the absence of such path-clearing. The first path that needs to be cleared for a new venture is often internal. Managers in established businesses frequently withhold time, talent or resources from something new. Worse, new ventures are often forced by the parent firm to go to market in the same way as existing businesses, which can completely undermine them.

One of our clients, for instance, is attempting to start a venture that will move the company beyond an established customer base of corporate IT managers who buy specific products from them to a solutions-sale at the enterprise level. Among the challenges facing the venture teams is the presumption at the corporate level that they will use the same marketing and distribution channels for both the new and existing businesses-a potentially fatal problem, because the new business appeals to a different level in the target companies and offers benefits that extend beyond the sphere of a typical IT manager. The technology development manager needs to reach a senior level to clear away that particular obstacle-by giving the venture team permission to develop an alternative channel and managing the accompanying channel conflict (Fortunately, this problem has now been recognized and the appropriate paths are being cleared.). Similar conflicts and obstacles need to be addressed with outside parties. Even great products and services can meet with resistance from customers, who are rightly concerned with the costs versus benefits of trying something new. To heat-shield, assurances need to be given that the company is deeply committed to the offering, that it is prepared to support it, and that the risks to customers are manageable.

For instance, in the global new elevator construction business, Finland's KONE Corporation developed a radically new elevator technology that eliminated the need for a separate machine room, creating substantial cost and design advantages for customers. Before this innovation could grow, however, an enormous amount of external path-clearing needed to take place. Not only did the new technology have to run a gamut of demanding regulatory approvals, but nervous prospective customers needed to be assured of its safety and reliability. In an appropriate series of heat-shielding moves, KONE management created enormous focus and drive around this activity, with its most senior leaders making sure that the obstacles to the adoption of the new technology (based on a patented innovation called the EcoDisc®) were removed, enabling five years of rapid growth based on that innovation. Sometimes, other members of the supply chain-distributors, suppliers, joint venture partners, and so forth-are needed to facilitate the new business launch. All too often, ventures have failed either because

of resistance from these essential collaborators or because they were not adequately prepared. The standards battle between Circuit City's Divx technology and the technology that is now commonplace in DVD players is an interesting example (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

Circuit City's sponsored Divx technology was an attempted replacement for video-store rental. Consumers would pay the price of a regular video rental to bring a disk home and view it within 48 hours, then either throw it away or pay an additional $15 to keep it permanently. Circuit City, however, failed to create critical mass around the new technology and only three manufacturers agreed to produce Divx disks. At the same time, other retailers flatly refused to carry the Divx product because of Circuit City's sponsorship, while video store rental outlets accelerated their move to offer DVD rentals because they viewed the success of Divx as a threat to their traffic. Circuit City ended up terminating the Divx venture at a reported loss of $375 million. Regardless of the merits of the technology, clearly an inadequate job of aligning key stakeholders was done. For publicly traded firms, a final constituency that needs to be attended to is a firm's stockholders and the analysts who assess its prospects. Failure to properly manage expectations while at the same time signaling growth potential can lead firms to suffer in the assessment of the market.

This all sounds straightforward, and so it is, if the technology development manager can persuade senior executives to make a significant commitment to launching a new venture. The dilemma is that this judgment typically needs to be made well before the potential risks and gains from a project are well understood. Waiting to get absolute confirmation of a venture's potential, brings about paralyzing delays. But jumping in too early can do enormous damage as well-witness the years of disappointing launches for personal digital assistants, which led to ridicule and brand-image damage to the firms leaping too early in the market. This will naturally lead senior management to be skittish about requests to "bet the ranch" before they have evidence that the risk is worth the bet. Your challenge as a technology development manager will be to find convincing evidence that the upside potential is there and the downside risk can be contained. Real options reasoning is useful in making this judgment, because it mandates limiting downside exposure until the upside potential of a venture is demonstrated.

For the championing challenges level, in meshing venture and firm needs role, as a venture team begins to gather resources to enter the market, finding the right resources and getting them to the right places involves more than making sure budget lines are approved. Team members with the right mix of process and content experience need to be recruited from existing operations, and the managers of these operations will not necessarily be delighted to release their valuable employees. The venture needs to be designed and launched in a way that

meshes with the parent firm's policies and its strategy. Organizational politics need to be considered one problem is that the resources going into a new venture are often both coveted and needed by managers of established businesses. You may have to champion the political process of securing their release from powerful incumbents in the existing business (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

A second integration challenge involves negotiating realistic terms under which the venture can operate. Attracting team members means providing them with appropriate incentives to join and grow the venture. Rules must often be bent to get a new venture going-for instance, rules about hiring, about job titles or hierarchical positions that are perfectly appropriate for a large mainstream business typically make no sense for a small team working on a new venture. When you think about it, most large and complex organizations are full of rules that are there for good reasons, but which can choke the momentum of a small venture-everything from building use policies, to internal corporate "taxes," to human resource restrictions. It falls to the champion to decide which rules should be heeded and which rules need re-negotiation. Often, internal accounting policies like corporate expense and asset allocations seriously and unrealistically distort venture performance unless you champion their removal.

A particular challenge for champions engaged in the integration task is that to succeed they must influence decisions at both the venture level and the senior management level without being in formal control of either. This can be immensely frustrating, as seemingly vast amounts of time are consumed by the delicate processes of negotiating agreements, keeping the necessary parties informed of progress and making sure that senior leaders are sending the right signals. Managing both "up" and "down" in the organization requires some skill, but even more a willingness to dedicate time and thoughtful planning to the task.

For the venturing challenges level, in redefinition and pruning role, market entry can seem paradoxical at the venture management level. On the one hand, venture managers must be ruthless in breaking down obstacles to the venture's success. On the other hand, market entry usually reveals lots of new information, which can suggest that a venture's path forward needs to be redirected. We would argue that the first set of behaviors is the most appropriate when uncertainty has to some extent been reduced, or the goal is to break into a clearly defined market quickly. The second, involving the capacity to redirect and change the venture is essential when uncertainty is high and a clear business model does not yet exist. In either case, venture launch is facilitated by the extent to which a team concentrates on identifying a few critical customers who will provide huge amounts of information about what is truly needed in the market. Launch is further facilitated by the use of a discovery-driven process that identifies the key assumptions underpinning the venture proposition, and then insists that key assumptions be tested at clearly defined milestones. Funds are then released at each milestone,

contingent on re-planning and redirection that take into account new knowledge revealed at that milestone (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

One of the great dangers in this part of the venturing process is falling victim to what psychologists call the "confirmation bias." This is quite simply the natural human tendency not to take in new information that calls strongly held assumptions into question. When a venture team has formed a set of beliefs, it will be very difficult to shake those beliefs, even in the face of disconfirming evidence, unless the venture leader makes it clear that even cherished assumptions are up for challenge. Our examination of great venturing flops revealed a pattern in which teams fix early on some guiding assumptions and never look back to re-examine them. The frenzied bidding by telecommunications companies for so-called 3G UMTS spectrum licenses fits this pattern-every bidder assumed that spectrum would be scarce and that operator would move rapidly to deploy the new networks. Despite challenges to this assumption, and some pointed observations from firms electing to bid, the dominant assumptions about the benefits of these 3G networks were not really questioned until some time after the bidding concluded, leaving many firms such as Deutsche Telekom with hugely expensive assets that at least in the near term do not show promise of generating new profits.

This is one of the places where the technology development manager must exercise the critical but highly unpopular role of pruning. As soon as it becomes clear at a major milestone that the assumptions are flawed and that there is no reasonable prospect of redirection you must shut the venture down and redeploy your team members to programs where they are needed. It is so difficult but so important to do this-to build an image that uncertain ventures will often be disappointing and that we need to try, to learn, and to move on to better things. How you handle such (increasingly frequent) disappointments that accompany increasing uncertainty will fundamentally imprint the spirit and motivation of those involved in business-building. This is complicated by the fact that it makes no sense to reward foolish failure. You need to have a process in place that assures a sound post-mortem and then celebrates by assignment to exciting new projects those team members who made good decisions but experienced bad luck, without rewarding those who made poor decisions.

In takeoff program: managing business-building, when the venture takes off and begins to generate accelerating revenues, project performance begins to impact the firm's overall performance for the first time. This can have unexpected consequences for the rest of the firm-positive and negative. At the same time, the nature of the venture's problem set fundamentally shifts; instead of the relatively few tough challenges of learning and transaction generation, operational problems now multiply as demands increase on facilities and people. Often, the managers who are best able to secure those tough first few transactions are not good at handling growing numbers of urgent problems. As technology development manager, you

need to be able to anticipate and prepare for this new set of challenges (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

For the heat-shielding challenges level, in maintaining focus role, one of your technology development manager tasks in this phase is to make sure that the venture team stays focused despite enormous distractions and associated temptations to cut corners. Insisting that quality, service, reliability of supply, and customer satisfaction remains high, for instance, can counterbalance the temptation to short-cut these conditions in the interest of expediency. Absent a focus on sustained high standards, high growth provokes rapid competitive entry into the vacuum created by declining standards, and competitors capitalize on the distractions created by growing operational challenges to the venture.

Together with focus, you need to be prepared to find and release financial and staffing resources-fast-for the growing operations of the new business. In some cases, the growth of a new venture requires a complete rewrite of the venture and even the company's budget and staffing plans. In one case we studied of a rapidly growing financial services venture, the explosion of accounts receivable essentially sucked up all available free cash flow in the business. At a corporate level, money had to be found from wherever it could be released-necessitating complete budget reviews with every company division to find ways in which to free resources. That year, the organization nearly imploded as the success of the new business overwhelmed the cash flows of the company. Obviously, decisions to re-budget and re-staff are not popular, and because they often have to be taken to senior levels of the company fast and decisively, you need to be able to anticipate this unpopular move and take it to higher levels before the venture starves from lack of resources.

For the championing challenges level, in redirecting resources role, it is highly likely that the venture team embroiled in a takeoff will be so distracted that it will have difficulty being proactive. As technology development manager, you need to be on the lookout for indications that the pressures and distractions of takeoff are not letting the following problems develop: Production capacity, for instance, may suddenly become scarce. If the new venture is operating with common capacity with existing businesses, tensions can erupt into deep internal conflict as the established business managers hold on to their "rightful" share of the line. Good people become scarcer than ever, creating enormous pressure on staffing plans and heavy workloads for support operations such as training, customer service and human resources. Quality can become strained, as capacity under pressure precipitates a drop in quality that is then baked into your product, which creates competitive vulnerability. Inability to supply the burgeoning demand can cause distributors or value chain partners to become disgruntled, again creating an opportunity for competition. Somewhat more subtle are the decisions involving which customer receives deliveries or services and who doesn't. The

wrong way to ration capacity is first-come-first-served. The right way is through some system that customers find fair but which aligns strategically important customers and distributors.

Among the most subtle processes to try to anticipate proactively are requirements for training. This might include training in customer service operations, training for people who actually work with the offerings or even training for customers and outside supply chain partners. Because training is not an instantaneous process, failing to anticipate the need for it can become a huge setback. Similarly, recruitment (ahead of need) of operations and service staff and qualified middle managers is often left to chance, and then managed haphazardly unless someone is proactively leading the charge. Companies also often overlook the problem that their rapid growth can put enormous pressure on their suppliers-in which case all the difficulties of proactive anticipation apply to the supply chain as well. A lack of quality or efficiency on the part of suppliers can lead to problems in your offerings that were not anticipated. Finally, you need to put in place processes that anticipate and counteract competitive attack. A golden rule in strategy is that all attractive markets attract competition, and visible, rapid growth markets do so dramatically. You need to be sure that your venture team anticipates these attacks and is able to mount an effective counter-strategy (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

For the venturing challenges level, routine-building role, even as the venture team copes with the pressures of growth, those operating the venture need to begin thinking about making it "a permanent fixture." An emergent venture must start putting into place the processes and systems (or routines) necessary for it to become a real operating business. The more that growth challenges can be addressed by making certain activities routine or systematized, the less has to be invented on the spot and the more effectively the challenge will be met. Thus, at this point you should start to push for standardization of some activities, for the development of organized systems for customer service and production, and the installation of policies and procedures. Standardization, not invention, begins to become important, and the infrastructure on which the later business will be built needs to start being developed.

One frequently overlooked aspect of this process is that the person with the skills to initiate a new business and launch it into the market may not be the right person to create the processes and systems to smoothly handle rapid growth. The very rule-breaking, innovative qualities that are crucial when the chief task is initiation can become liabilities when the job is to bring order to a turbulent situation. With many organizations, the reward for starting a venture is to be given the opportunity to run the business that emerges from it-unfortunately, this has often been exactly the wrong person to run the business, and often they don't want that role anyway. If this is the case, your technology development program could lose a rare and valuable start-up manager who leaves in disgust or disgrace because of your lack of insight. Technology

development managers need to be sensitive to this possibility. Often, the solution is to bring in a different manager or management team to handle the challenges of growth. Alternatively, you need to spot when the time has come to introduce such skills into the management team and bring in people who have appropriate experience. Coping with growth, therefore, often means a transition in the management skills that are most needed and may imply a transition in management. All the techniques of effective change management come into play here, as the entire organization goes through a series of often-wrenching changes in people, processes and systems.

The goal during this phase of the venturing process is no longer to create a new business but to build a proven commercial proposition into a solid new piece of the firm. Effective venture managers thus begin to focus on standardization, quality and reliability. The right people for this task are able to define a set of core key priorities and manage the details of the business. It is then time for you to orchestrate handoff to the established organization and get on to the new opportunities in your technology development program. Over ten years of observation and study of the evolving challenges facing those charged with the development of firms' technological assets has led us to conclude that the winning firms in the technology game will be the ones that forge technology development programs focused on business-building rather than R&D. This suggests that more traditional technology management positions will give way to a new executive responsibility which we call technology development manager. Effectively filling this executive position is no mean task-managers charged with converting the silo-oriented R&D mentality to one of business-building face many challenges. The challenges can be perceived in terms of nine major roles for the technology development manager, encompassing the major sets of activities (pipeline-building, market entry and takeoff) attacked at three levels of challenge (venturing, championing and heat-shielding). We have outlined in some detail what each of the nine major roles entails, based on our observations of managers and companies that have succeeded in their struggles with business-building (Research Technology Management, 2004, Vol.47, Iss.3, page 16-26).

## 2. Introducing R&BD Programs including Korea

What is SBIR (Small Business Innovation Research) Program of the United States? SBIR is a highly competitive program that encourages small businesses to explore their technological potential and it provides an incentive to profit from commercialization (http:// www.sba.gov/SBIR). The Small Business Innovation Research (SBIR) Program is a highly competitive three-phase award system which provides qualified small business concerns with opportunities to propose innovative ideas that would meet the specific research and R&D

needs of the Federal Government. Congress designated 4 major goals of SBIR as follows (The followings are four major goals of SBIR designated by the Congress):

- Stimulate technological innovation
- Use small business to meet federal R&D needs
- Foster and encourage participation of minorities and disadvantaged persons in technological innovation
- Increase private-sector commercialization innovation derived from federal R&D

Small Business Technology Transfer (STTR) program together with SBIR is a program for fostering technology transfer between small business concerns and research institutions.

There is also a program named SBRI (Small Business Research Initiative), program of United Kingdom (http://www.dti.gov.uk/innovation/sbri/index.html). What is SBRI program of United Kingdom? It is a program which designed to help small and medium Enterprises (SMEs) gain greater access to publicly funded Research and Development (R&D) contracts. It does not give grants but it does provide a alert service about government procurement opportunities. The SBRI aims to provide opportunities to those existing small firms whose businesses are based upon providing R&D - by increasing the size of the market, to encourage other smaller businesses to increase their R&D capabilities and capacity - to exploit the new market opportunities, to create opportunities for starting new technology-based or knowledge-based businesses. The initiative is open to all businesses. However it is particularly beneficial to SMEs. An SME is classed as a business that has fewer than 250 employees; and either an annual turnover not exceeding about £34m (€50m) or a balance sheet total not exceeding about £29m (€43m); and when determining whether thresholds are reached, it is necessary to take into account the same data i.e. number of employees, annual turnover, (balance sheet total) of 'partner' and 'linked' enterprises. Charities, university spin-offs, individuals and groups are eligible to participate if they fulfill the above criteria.

Another well-known program is BUNT (Business Development using New Technology) program of Norway (Hakon Finne, Morten Levin and Tore Nilssen, 1995). What is BUNT program of Norway? It is a program experiencing success of this policy type and gaining popularity as bench marking work for the other nations. Research Council of Norway established BUNT program to close ‘technology gap’ between the available technology in the research institutes and small and medium-sized enterprises (SMEs). The target group was industrial production companies facing competition, with over 20 employees. BUNT was to stimulate an increase in the demand for new technology by identifying technologies that would fit into the strategic plan of companies, rather than through the old model of finding companies that might adopt particular technologies. It was important that investments in new

technology should be motivated by commercial considerations. A working methodology was developed, in which specially trained consultants were to take on the task of disseminating strategic thinking to participating companies.

In the BUNT program 120 experienced Norwegian consultants were trained to work according to this model. The training was quite extensive. The consultants were to carry out strategic analyses in individual companies, aided by a tool kit developed for the purpose. These analyses were to form the basis for action plans for the implementation of prioritized measures. The American-type strategy model of BUNT program emphasized that for each product market combination the company must choose whether it wished to focus most on price, quality or other aspects. Then the company had to draw up action plans with measures (technological, financial, organizational, etc.) which supported the strategy. Besides the strategic analyses in individual companies (which eventually numbered over 300), many individual projects were planned. Such projects were to take up special themes and could be experimental in nature; the portfolio of experimental projects had great scope. The BUNT program itself has generally been judged successful (not just by the evaluators), and the BUNT concept -including, to some extent, the developed evaluation model- has become something an export commodity. The BUNT program currently infuses several business development programs in Eastern and Western Europe.

## 3. Case studies on R&BD Programs

### 3.1. Ministry Of Industry and Energy, “Northeast Asia R&BD Hub Construction” Propulsion

Korea tries to overcome the sandwich situation between Japan and China using R&BD. Korea also wants to sustain a world-wide competitive power while establishing 'Northeast Asia R&BD hub' which specially focuses on the research and development concerning the marketing and commercialization.

In order to implement 'Northeast Asia R&BD hub' the Ministry of Industry and Energy will establish a few major policies as follows:

1) To improve R&BD environment to the level of developed countries such as that of Silicon Valley of USA.

2) To make plans based on SWOT (Strength, Weakness, Opportunities, Threat) analysis

3) To upgrade man power, research facility, technology development programs

### 3.2. Policies for Promoting Innovation-oriented SMEs in Korea

Published in KDI 36th Anniversary International Conference On "Financing Innovation-Oriented Businesses to Promote Entrepreneurship: Experiences of Advanced Countries and Lessons to Korea," April 26, 2007, [Session 4] Government Policies to Promote Entrepreneurship and Innovation

1) To increase the number of Innovation-oriented SMEs up to 30,000 until 2008

2) To expand R&BD investment including governmental institutes

3) To support more R&BD projects

4) To guide SMEs to develop new markets

5) To establish the infrastructure for R&BD SMEs

6) To activate M&A in the market

7) To help R&BD get more fund from the financial market such as KOSDAQ and venture capital

### 3.3. A Case of R&BD SME in Korea

Yujin Robotics was established in 1988. Its main items include vacuum robots, home robots and industrial robots. The amount of its net income becomes US$1.5 million during the 1st quarter of Year 2006. The amount of investment is about US$12 million and 30 employees accomplished the project successfully.

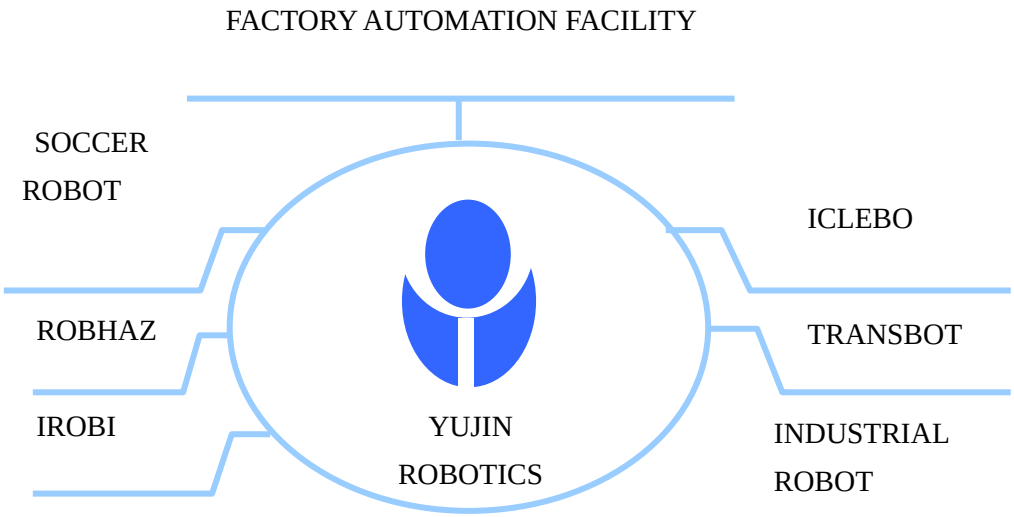



**Fig 1 R&BD Products of Yujin Robotics**

### 3.4. A Case of Market Orientation, Innovativeness, Product Innovation, and Performance in Small Firms

In Journal of Small Business Management, it is accepted widely that market orientation has a positive influence on the performance of firms (Journal of Small Business Management, 2004, Vol.42, Iss.2, page 134-154). This relationship not only has been established firmly for large companies but also has been found in research on small and medium-sized enterprises (SMEs) (Pelham 2000). This study contributes to this matter by developing and testing a model of the relationship among market orientation, innovativeness, product innovation, and performance in small firms. In this context, the small firm is defined as one that is run and is controlled under the direct supervision of the owner. This article is structured as follows. First, the concepts and notions on market orientation and innovation relevant to this research are reviewed. Second, market orientation and innovation for small firms are specified, and a model is proposed that expresses the relationship among market orientation, innovation, and performance in small firms. Hypotheses on these relationships are presented. This study's model is tested on a specific type of small firm: rose growers in The Netherlands. Finally, managerial implications of the results are discussed, and suggestions for further research are made.

The specific resources and capabilities of small firms have consequences for market orientation as defined by Kohli and Jaworski (1990). In small firms, resources for market intelligence generation are scarce, and there is no room for a marketing specialist. In fact, market intelligence is based mostly on secondary data (from trade journals, sector research,

conferences, and professional magazines) or on personal contacts (with suppliers, customers, or bank employees) (Smeltzer, Fann, and Nikolaisen 1988). When small firms sell a differentiated product in a local or regional market, they can use market intelligence more effectively. Advances in information technology (IT) will be helpful in this respect. Intelligence about suppliers and colleagues is very useful for small firms in order to innovate processes, products, and services. The dissemination of market intelligence is not a relevant issue in small firms where the owner makes the major decisions. However, the dissemination of market intelligence to other people in the firm might increase employee motivation. In fact, Ruekert (1992) showed that market orientation is related positively to job satisfaction. Small firms run by the owner can respond with alacrity and flexibly to market intelligence because decision making is non-bureaucratic and because the decision-maker is able to oversee the whole production and marketing process (Carson et al. 1995; Nooteboom 1994). On the other hand, their responsiveness is constrained by limited financial and technical resources.

Limited resources and capabilities, as discussed, prevent small firms in many industries from conducting in-house research and development activities. Many innovations by small firms are based on off-the-shelf technologies, concepts, and/or resources offered by supplying industries. As a result, new inputs are a very important source of innovations for small firms. Networks of small firms can establish collective research and development (R&D) programs as a basis for product innovation of network members. Cooperative competencies (Sivadas and Dwyer 2000) of participating firms seem important for the success of such programs. Small firms that produce differentiated products also can innovate individually by adapting products to the needs of the target group of customers.

This study’s results confirm that, in line with the growing amount of evidence about the positive impact of market orientation on company performance, customer market intelligence is related positively to company performance of small firms. Customer market intelligence probably is helpful to perform better in terms of quality, service, or timing, which results in better RPP. Consequently, customer market intelligence about the augmented product such as intelligence about quality and service requirements offers opportunities to become a preferred supplier. Future research should elaborate on how small firms differentiate their products based on customer market intelligence. Our results also show that for small firms in markets with relatively homogeneous products, a market orientation is helpful in the selection of an attractive product assortment. It confirms the value of market information about the generic product for small firms. (Journal of Small Business Management, 2004, Vol.42, Iss.2, page 134-154)

Innovativeness of the owner, one dimension of an entrepreneurial orientation, appears to be an important characteristic of a small firm because it is correlated highly with performance, as

measured in these analyses, and it permeates all variables in the model. This result is in accordance with research findings from the past, which stress the entrepreneurial skills of farmers as the decisive variable in the success or failure of a farm business (Zachariasse 1974). Moreover, the effect of customer market intelligence on innovation depends on the owner's innovativeness in a specific domain. Exploring other dimensions of entrepreneurial orientation seems worthwhile to increase our understanding further of the impact of customer market intelligence for owners of small firms with different entrepreneurial orientations. This study's results show that customer market intelligence provides value to customers through product innovation by small firms. Keeping in mind that small firms largely depend on secondary data for customer market intelligence, an effective infrastructure for conducting collective market research is important for product innovation and the competitiveness of small firms. Customer market intelligence about the newest products that are accessible for small firms will stimulate the production of new products that offer value to customers. To stretch the value of collective customer market intelligence, entrepreneurs should be trained in making effective use of such data (Smallbone and North 1999).

These results demonstrate the value of a mixed population of small firm owners with respect to innovativeness and market orientation. Small firm owners, who are highly innovative in a specific domain, may adopt innovations without clear information about its market acceptance. Market-oriented small firms copy the successful innovations once customer market intelligence becomes available. Moreover, customer market intelligence stimulates small firms that would otherwise lag behind in innovation. Consequently, the innovativeness of small firm owners is a crucial asset, which stakeholders of an industry such as governments and suppliers should cherish. Restrictions on innovativeness, via legislation, or conservative financing may propel entrepreneurial owners of small firms out of an industry, which will deteriorate its competitive position.

### 3.5. A Case of New Product Market visioning in Small Enterprises: A preliminary empirical study within the Central Technology Belt in England

In Journal of Small Business and Enterprise Development, increasing competition, continuous technological breakthroughs and rapidly changing customer requirements are manifest in today's business world, and contribute to the shortening of product life cycle (Journal of Small Business and Enterprise Development, 2007, Vol.14, Iss.1, page 81-92). Consequently, the pressure on all business enterprises to continuously innovate, so as to enable themselves to develop and launch new products and services, is greater than ever. The successful development and launch of new products and services is fundamentally important to the survival and success of business enterprises, irrespective of whether they are large or small (Wynarczyk, 1997).

The performance and the processes are two of the most heavily researched themes in new product development and launch. However, prior to endeavoring along the new product development processes and then evaluating the performance of the output arising from the processes, it is imperative that the business enterprises concerned need to possess the readiness and capability to visualize a future market, which a new product can be developed for and launched in. We call this “new product market visioning”, which is different from the concept of vision or visioning in the subject area of strategy. New product market visioning is all about the readiness and capability to visualize a potentially lucrative future market by recognizing the implications of any new technology externally to the firm, seeing the potential of technologies emerging in one’s own research and development laboratory, formulating the still emergent nature of a future market that may be far beyond the current market and that can be developed further, and knowing which direction to move along by bringing all these technological and market insights together and develop new product that can be profitably commercialized.

The only major article genuinely on new product market visioning, written by O’Connor and Veryzer (2001), is an exploratory study on nine large, mature organizations attempting to develop greater understanding of the nature of market visioning for technology-based radical innovation. Four themes emerge from the results of their study. First, vision is established and sustained through a number of mechanisms that may function at the same time or operate one after the other. Second, the “visionary” staff members who participate in creating and evangelizing a vision are playing different roles. Third, to assist in developing visions, the “visionary” staff members adopt a number of tools and methods, yet these are not systematically employed by the organizations concerned. Finally, visions, which may reach out far beyond the current market and customer base, usually need to go through a process of validation and internal acceptance.

However, there are two inherent elements of the nature of the article that severely limits its ability to represent a wider market. First, the article is very exploratory in nature. Although a number of themes have been figured out from the results, these are still in quite a vague state. Undeniably market visioning itself is difficult to be crystallized, yet it is possible to reduce the degree of fuzziness through a more conclusive research design. Second, the companies participating in the study are all large, mature organizations, and therefore any result may not be applicable to small to medium-sized organizations, which form the bulk of the total number of organizations in virtually any country. In the case of the UK, small to medium-sized organizations account for approximately 50 per cent of the national turnover, and represent over 95 per cent of the total number of companies in the country. In the county of the West Midlands, whose Central Technology Belt region is the target of the survey for this study, the number of small to medium-sized organizations approached 300,000 in 2002 and continues to

grow. These small to medium-sized organizations may be very different from their larger counterparts in the state of knowledge and practice of market visioning. They are always renowned for their innovativeness, which can facilitate their understanding and implementation of the concept of market visioning. On the other hand, their readiness and capability to visualize a future market can be impeded by their general lack of financial strength. It is therefore academically stimulating to probe into the extent to which small enterprises, given their general characteristics, are grasping and utilizing the concept of market visioning (Journal of Small Business and Enterprise Development, 2007, Vol.14, Iss.1, page 81-92).

Overall results of this study on the small firms in a technology belt in the West Midlands, England, demonstrate that the contexts for new product market visioning for these firms are not satisfactory. Compared to the larger firms, not only are they less able to understand their potential for developing new products, predict market reactions to their new products, as well as forecast what products are the “future products” for them, but they also have devoted less adequate efforts on formally reviewing and informally monitoring their existing portfolio of products, and auditing the market feasibility of any new product they develop. It is understood that smaller firms are more innovative than larger firms. However, innovativeness itself does not necessarily lead to better market visioning of new products. To nurture fertile contexts for new product market visioning, a small firm has to do proper review, audit and whatever is needed in order to have a systematic and comprehensive understanding of where they are and where they can go. Without all this homework, a smaller firm may still be able to launch new products, some of which could be successful. Yet this is more of a hit-and-miss style and therefore results in an unnecessary waste of resources. On the other hand, with appropriate efforts on nurturing the contexts for new product market visioning, coupled with the innovativeness of small firms because of their flexibility and less rigid organizational structure, they can stand a higher chance to achieve an impressive rate of conversion from opportunity product concepts to successful product concepts (Crawford, 2003).

### 3.6. A Case of Market Driven Innovation

In The Small Business Economy, William Baumol has provided striking evidence indicating that private innovative activity has been divided by market forces between small firms and large, with each tending to specialize in a different part of the task (The Small Business Economy, 2005, page 183-206). Even though the preponderance of private expenditure on research and development (R&D) is provided by the giant business enterprises, a critical share of the innovative breakthroughs of recent centuries has been contributed by firms of very modest size. These radical inventions then have been sold, leased or otherwise put into the hands of the giant companies, which have then proceeded to develop them—adding capacity,

reliability, user friendliness and marketability more generally—to turn them into the novel consumer products that have transformed the way Americans live. Baumol has referred to this division of labor as the "David-Goliath partnership," the value of whose combined products clearly exceed the sum of the parts. To the extent that the facts confirm this characterization, it is evident that the small enterprises have made and continue to make a critical contribution to the market economies' unprecedented growth and innovation accomplishments. Without breakthroughs such as the airplane, FM radio, and the personal computer, all introduced by small firms, life in the industrialized economies would be very different today. Moreover, without these breakthrough inventions to build upon, the big companies would be confined to a much more restricted body of ideas to which to devote their development activities.

This study paper seeks to show that the division of innovative labor is no accident. It is the market mechanism that assigns each type of firm to its differentiated job. It is the market mechanism that assigns the search for radical inventions to the small enterprises and their subsequent development to the large. The author describes how the market does so, and how it prevents either group from a massive invasion of the other's terrain. If, as the evidence indicates, the free market is of critical importance for America's unparalleled flood of innovation, and if widely and rapidly adapted innovation is the primary key to that growth, then it will follow from the analysis that small firms are indeed indispensable components of the process and that rapid and sustained growth cannot get along without them. For ease of thinking, it is convenient to divide up inventions into two polar categories: revolutionary breakthroughs and cumulative incremental improvements. Of course, many new products and processes fall into neither extreme category, but are somewhere in between. Still, it will become clear that the distinction is useful. Moreover, there are many examples that clearly fit into one of these categories or the other quite easily. For instance, the electric light, alternating electric current, the internal combustion engine, and a host of other advances must surely be deemed revolutionary, while successive models of washing machines and refrigerators—with each new model a bit longer lasting, a bit less susceptible to breakdown, and a bit easier to use—constitute a sequence of incremental improvements.

The central contention here is that the division of innovative effort between small firms and large is neither accidental nor it easily terminated. On the contrary, strong market forces drive both actors toward these assigned roles and make it difficult for the entrepreneurs and firm managers to act otherwise. The distinction between the two explanations—historical happenstance versus market forces that induce or perhaps even enforce it—is important not only for research and understanding, but for policy as well, because it can help in anticipating whether this apparently efficient arrangement can be expected to continue with no deliberate intervention to preserve it, or whether some policy measures will be required for the purpose (The Small Business Economy, 2005, page 183-206).

It will be suggested here that there are nevertheless significant overall differences in the influences faced by the two types of enterprise, and that these differences can account for the division of innovative labor that one observes between them. Moreover, if these causal attributions are valid, it will follow that the specializations of the two types of firm are not markedly transitory but, on the contrary, can be expected to remain for a substantial period in the future. The heterogeneity of enterprising behavior precludes any universally applicable scenario, particularly one that imposes a uniform response upon the entrepreneurial firms. In this respect, the story differs from that of the innovating oligopolists who, the author maintains, are normally driven in similar ways by powerful market forces toward their specialization in incremental improvement. For the small firm, several pertinent and important influences are also ingrained in the economic environment, but these are rather more amorphous, not stemming from a pure profit calculus or any market-imposed threat to their survival.

The focus here is on three mechanisms that characterize the relation between the market and the entrepreneurial firm. They can be suggestively referred to as: 1) the superstar reward structure; 2) the psychic rewards to innovative activity; and 3) the scarcity and cost disadvantage of large firm competition in the arena of breakthrough innovation. Each will be discussed in turn, but first an observation that relates to them all. As is to be expected, the market does provide clear incentives for entrepreneurs to undertake the hazards of radical innovation. But, paradoxically, each of the three mechanisms to be discussed entails financial underpayment of the average innovative entrepreneur. That is, it entails the expectation of financial returns lower than those to corporate employees with similar education and experience who provide comparable efforts. Thus, in what follows, it will be necessary to account, first, for the comparative paucity of breakthroughs that emerge from the sizeable labs and affiliated facilities of the large, established, and innovative firms. Second, why are a significant group of entrepreneurs and inventors, albeit a comparatively small one, willing to undertake the great uncertainties and the typically enormous personal effort that pursuit of this objective requires? The issue is not why there are so many that do so, but why there is a significant set of these adventurers at all.

Until now a critical role has not been assigned for the market mechanism in eliciting disproportionate allocation of entrepreneurial activity to breakthrough innovation. The market does play such a role. Psychic benefits are a very tangible reward to the recipient but are generally costless to the provider. This implies that an innovative entrepreneur who on average receives great pleasure but meager financial rewards from the activity may nevertheless be richly rewarded overall. But the low financial payment means that innovations obtained from this source are purchased cheaply in financial terms, giving this sector of the economy a marked competitive advantage. That is, the independent innovative entrepreneur

will tend to be the economical supplier of breakthrough innovation to the economy. One of the virtues of markets and competition is their ability to move economic activities toward those suppliers who can provide them most economically. In the case at hand, it means that the low-cost psychic reward component of the independent innovator's compensation will make it more economical for the large firm, in considering its make-or-buy options, more generally to acquire its breakthroughs from others rather than seeking to provide them in-house. Firms are forced to do so for fear that if they do not, their rivals will. This, then, suggests one market-based reason (that is not mere happenstance) why a disproportionate share of radical innovation stems from the independent entrepreneur.

The tendency of large firms to be risk averse in their R&D activities is well recognized. As a clear illustration of that attitude and its implication for the innovation process, the author has previously quoted the following observations by a member of management of one of the world's major high-tech enterprises: How then are choices to be made in the allocation of society's R&D resources in this critical arena? Government has little qualification for the task and big business will not do it. It is only the innovative entrepreneur who is prepared to take on the burden. The task is performed largely by trial and error, using what little information and what large doses of experience and intuition are available to the entrepreneur, because there is no other way. And the process entails a heavy cost to many of the entrepreneurs—whose guess is wrong. But the basic point is that in undertaking this task, the allocation of so critical a portion of society's R&D resources, the entrepreneurs make an enormous contribution to the general welfare, often at their own expense. It is a job that needs to be done, no one else will do it, and imperfect though the selection turns out to have been in hindsight, no one else could have done it any better (The Small Business Economy, 2005, page 183-206).

Three attributes of entrepreneurial activity facilitate its role as conduit from the ghettos and other enclaves of poverty. The first and most obvious is that it requires no consent of an employer. At least in the United States, where some minimal licensing requirements are all that impede the process, for all practical purposes, all entry requires is the determination to do so. Second, there are opportunities that require very little sunk capital, and many an entrepreneur has, indeed, started on a shoestring. The third attribute, which seems not to receive the attention it deserves, is its education requirement: virtually zero. The successful entrepreneur obviously needs to be clever and, indeed, sometimes requires some wisdom. But the great success stories are populated by school dropouts and avoiders of advanced education. Both Edison and the Wright brothers were active entrepreneurs and not just inventors. Edison dropped out of school at age 12 and the Wrights never attended high school. Other examples abound, all illustrating that advanced education is hardly an inescapable job requirement or indispensable for good performance as an entrepreneur. This is important because education is time-consuming and expensive, at least in terms of income foregone, even when government

pays the bill. Society's islands of poverty are also aggregations of uncompleted education. Lack of education is often a handicap that cannot be overcome by those who seek jobs with any degree of promise for the future in established enterprises. But it does not close the door to exercise of entrepreneurship, and that is no negligible virtue.

This study has gone beyond the observation that breakthrough advance in technology is predominantly a small firm specialty. There is a good deal of evidence that this has been the case for over a century and that it continues to be so today. True, the giant oligopolies provide the overwhelming preponderance of R&D expenditures, but in general those outlays are carefully directed to projects with minimal risk, which are therefore apt to yield non-negligible improvements, but improvements that typically are only incremental. This paper has inquired into the influences that can account for this division of labor and has offered a number of observations that indicate that the phenomenon is hardly an accidental occurrence. More important, the analysis, if supported by the evidence, indicates that this distribution of the task of technological advance can, with a degree of confidence, be expected to continue. This underscores the contribution of the innovative entrepreneurs to the growth of the economy and the welfare of society. Three such contributions are emphasized here. The first, the focus of the article, is the entrepreneur's provision of the radical innovations that underlie the profound changes, since the Industrial Revolution, in the way Americans live. Second, it has been noted that the innovative entrepreneurs as a group carry out the task of selection of the projects to which the resources available for the search for radical breakthroughs are allocated. This is a task critical for the future of the economy, but it is a task from which others shrink because of the great uncertainties it entails. Finally, recalling the evidence that innovative entrepreneurs have often succeeded, and succeeded spectacularly, with little formal education, it has been pointed out that this serves to reduce further the naturally low barriers to entry into the activity. That, it turn, helps to fill a need critical for society: an attractive and promising avenue toward prosperity (The Small Business Economy, 2005, page 183-206).

## 3.7. A Case of Asia Foundation Experience in Indonesia: Unleashing Small Business Growth

Throughout Asia, small businesses are a critical component of local economies. The Asia Foundation has developed an innovative approach to helping small businesses grow — rather than providing direct assistance to firms, the Foundation directs its activities towards improving the business environment, working with grassroots business groups that advocate market reforms, and providing technical assistance to local institutions tasked with implementing reforms (http://www.asiafoundation.org/pdf/indo_SME.pdf). The Foundation has six years of experience implementing such programs in Indonesia and is a leader in the field of building private-sector engagement in policy reform. This approach complements the efforts of other organizations

that provide business development services or financial services to the small business sector. Building on the lessons learned in Indonesia and adapting the framework to suit local needs, The Asia Foundation is in the process of developing significant programs directed at the small business community in Bangladesh, Nepal, the Philippines, and Cambodia.

Businesses employing fewer than 20 people employ roughly 90 percent of the population in Indonesia, a statistic similar to that of other developing countries in Asia. Traditionally overlooked by economic development strategies that emphasized the creation of large and often State-owned companies, small businesses have garnered increasing recognition in recent years for two primary reasons. The first is their ability to generate employment — thereby reducing poverty — with limited capital. As large, well-connected firms continue to founder in the wake of the Asian financial crisis, small businesses have absorbed the unemployed and played a fundamental role in ensuring the economic survival of many families. Small businesses are important for growth, as well. The presence of a dynamic private sector made up of all sizes of business is an important indicator of a healthy economy.

In much of Asia, however, small businesses operate in an environment where State-owned enterprises or well-connected large companies continue to be granted privileged access to resources, procurement contracts, and regulatory concessions. Small businesses, in contrast, face a heavy burden of restrictive regulations, levies, and licenses. They bear tremendous financial costs and must allocate considerable amounts of time to obtain the multiple licenses that are required to operate legally. Moreover, these local regulations are frequently amended, and this constant state of flux leads to new opportunities for corruption. Sometimes the problems are unintentional, but still costly, for small businesses. Poor governance in some countries produces regulations and procedures so obtuse that entire industries of middlemen spring up to expedite the processes. Even when institutions do not formally exclude them, small businesses owners may find themselves on the outside looking in. For example, cultural barriers prevent many from approaching lending institutions, even those that exist to serve small borrowers.

The Asia Foundation is a nonprofit, nongovernmental organization dedicated to the development of a peaceful, prosperous, and open Asia-Pacific region. Working out of 17 offices across Asia, the Foundation sponsors a wide array of programs that support the reform process by strengthening local partners who actively advocate greater openness, greater transparency, and greater participation. These programs fall into the broad areas of governance and law, economic reform and development, women’s participation, and international relations. In Indonesia, the Foundation has been responding to the real and pressing needs of small businesses since 1996. The Partnership for Enterprise Policy Reform program, funded by USAID, works to improve the business environment by broadening

private sector participation in government decisions on small business policy. The program is also enabling greater access to credit at the local level through a better functioning financial system. Lastly, the Foundation works to increase the availability of relevant technology and information to and among small and medium enterprises (SMEs).

The Asia Foundation has succeeded in making substantial improvements to small business policy and its implementation. Those policy is about simplified licensing of SMEs through local one-stop licensing and registration, resulting in a dramatic increase in the formalization of small businesses in some areas; Supported the drafting of anti-monopoly legislation that includes State- owned enterprises and continues support of advocacy for the bill's passage; Convened the first independent National SME Owners Congresses in Indonesia in 1997, and supported subsequent congresses in 1998, 2000, and 2002; Facilitated the creation of more than 60 independent, regional small business associations across the country; these associations represent more than 1,500 small businesses in a wide range of sectors; Initiated and institutionalized the mechanisms that incorporate input from these business associations into local policy processes; Identified and reduced special levies and other costs imposed on SMEs; Ensured stakeholder input on a bill to regulate microfinance institutions for the first time; Deregulated the halal certification process (which formally identifies food that is allowable for consumption by Muslims). Advocacy by local business associations led to the retraction of a decree requiring labeling by a monopoly office that was placing an onerous burden on SME food producers; Convened dialogues between the regional and national business associations and big retailers on consignment practices that resulted in new payment practices to better meet the needs of SME producers; Created an advocacy fund to support local efforts to improve the policy environment. The fund has disbursed $80,000 over 4 years to more than 40 business associations; and Conducted an unprecedented 10-city survey of local business environments for SMEs that was designed to reveal the strengths and weaknesses of each city and to promote healthy competition for the best business environment. A second survey, currently in process, has received substantial support from Indonesian companies, which have contributed $20,000.

When the Foundation began its work with small business in Indonesia, existing business associations involved selected groups of well-connected businesses. These business groups, often organized along sectoral lines, usually advocated behind closed doors for advantageous treatment of their own businesses or industries. The Foundation initiated the establishment of the first independent small business associations in 1997. Today, there are more than 60 small business associations serving more than 1,500 member businesses across Indonesia – from Sumatra to Papua – and they have engaged successfully with local and national government on issues ranging from corruption to monopolies, credit, and relations with large companies (http://www.asiafoundation.org/pdf/indo_SME.pdf).

The business associations are initiated by local businesspeople, often after they have enjoyed exposure to other Foundation-supported business associations, and are driven by members' interests. Often run by volunteers, they function essentially as local chambers of commerce, representing the interests of independent small businesses in the principal cities and towns. In addition to their advocacy activities, the associations play an important role in circulating market information and providing networking opportunities. The value of these services is evident in the associations' ability to collect dues: associations receive no operational support from the Foundation for rent or salaries, only technical assistance and grants for policy related activities.

Every two years, the Foundation supports a national conference that brings together the local business associations from across the country. These conferences give national prominence to the needs of small business by applying their collective political weight to issues of common interest in front of prominent officials from the national, provincial, and local governments. More than 100 SME owners from more than 20 provinces attended the third national conference, held in 2000 in Yogyakarta, as did representatives of central and local government agencies, analysts, the private sector, and the media. The fourth conference, in August 2002, enjoyed even greater numbers. In addition to bringing regional concerns to the capital, the national meeting allows businesspeople from across the country to trade information on markets and technology and to share ideas and experiences on organizing business associations.

The Foundation also created and manages an advocacy fund that receives proposals to fund business association activities related to the local business environment. Business associations apply for funds on a competitive basis, and proposals are judged by a joint group of The Asia Foundation and its partners on the basis of their potential impact and demonstration of cost sharing. Activities supported under the fund include: advocacy on unclear bureaucratic procedures for business licensing, advocacy on anti-competitive behavior by State-owned enterprises which reduces opportunities for SMEs, advocacy on unfair business practices by large retailers, and advocacy on illegal levies that have to be paid by SMEs. Over the past four years, approximately $80,000 has been distributed to more than 40 business associations.

Dynamic entrepreneurs are always seeking ways of expanding their operations. This requires access to information regarding consumer demands and alternative production technologies. Usually, entrepreneurs collect this information from the market. But small businesses in remote locations face higher costs in accessing this information, and these costs may be prohibitive, effectively locking efficient producers out of the market. Information technology makes it possible to reach new markets and lower communications and marketing costs. The Foundation is helping SMEs to take advantage of these opportunities. Activities thus far

include a survey of eCommerce use by SMEs in Southeast Asia. As in the Foundation's general policy activities, this research formed the basis of policy recommendations that are being promoted in public-private dialogue meetings around Indonesia. While the impact on local businesses was discussed, the regional aspect of the survey also allowed policymakers to see how the regulatory environment and adoption rate in Indonesia compares to competitor countries, such as Thailand and the Philippines (http://www.asiafoundation.org/pdf/indo_SME.pdf).

The Foundation is also supporting the development of an SME web portal that will increase access to critical business information and foster ongoing communication between the business associations and their members. The website will disseminate locally gathered information, including changes to local and national business regulations. Having a centralized source of information will offer businesses the additional advantage of comparing differences in regulation across provinces. This online service will also provide information on areas of interest to SMEs, including the local business environment, contact information for association offices and members, relevant market data, and the product information of members in order to create linkages between upstream and downstream producers.

The Asia Foundation is sponsoring a major marketing effort through the business association offices to build the user base of the website and to encourage participants to contribute information and content. In addition, the Foundation is working with government agencies to formulate a process for posting government data and content. The Foundation is also providing grants to local business associations to support the buildouts of their local portal websites, as well as to purchase computer hardware and Internet access.

### 3.8. A Case of Innovation and Technology Transfer in Chinese Agriculture

In Journal of Small Business and Enterprise Development, the transfers of scientific and technological achievements in the agricultural sector, despite consistent improvement over the years, remains as low as around 40 per cent (Journal of Small Business and Enterprise Development, 2006, Vol.13, Iss.2, page 242-247). It is estimated to be only half of that of developed economies. The low level of technology transfers has not only wasted valuable resources of science and technology available to the agricultural sector but has also hindered the development of agricultural and urban economy. To meet the requirements of agricultural development and to prepare for competition in the international market after China's entry into the World Trade Organization (WTO), the Ministry of Science and Technology (MST) and the Ministry of Finance (MoF), in conjunction with the Ministry of Agriculture (MoA), the Ministry of Water Resources (MWR), and the State Forestry Bureau (SFB), established in April 2001 the "Fund for the Transformation of Scientific and Technological Achievements in Agriculture" with reference to the relevant clauses in the "Green box policy". In August 2001,

MST and MoF jointly issued a series of documents, including the “Guidelines for projects of the fund for the transformation of scientific and technological achievements in agriculture in 2001” and the “Interim provisions of managing projects of the fund for the transformation of scientific and technological achievements in agriculture” and “Appraisal manual”. They also co-sponsored workshops to formulate general plans for the transformation task.

The “Fund for the transformation of scientific and technological achievements in agriculture” is a platform for the Chinese government to channel funding into agricultural science and technology and to foster technology transfer and progression of industrialization. According to the “Green box policy”, there is a pressing need to gear up agricultural restructuring, for the benefits of agriculture in general and for an increase in farmers’ income. In addition, it is an effective tool in the implementation of the “Green box policy” to support agriculture after China’s entry into the WTO. The establishment of the fund was intended to resolve problems in the separation of scientific research and technology development from agricultural production, while taking into full consideration of different characteristics in each region and the fact of agricultural production. So far, the projects with funding from the fund have generated remarkable economic, social and ecological benefits.

The fund focuses on relatively mature technologies. Through regional trial and demonstration, mid-test or commercial experiment, technologies would eventually reach the pre-application stage which allows the science and technology (S&T) achievements to be transformed to actual applications. Depending on the characteristics of projects and organizations, the funding could be used as subsidies for the payment of loan interests, volunteer grant, and capital investment. The establishment of the fund encouraged all regions and relevant organizations to take up the transformation work and to promote positive interactions among agricultural production, education and research. Statistics show that by the end of 2003, local governments and corporations had invested 3.06 billion yuan as match funding, with 0.26 billion from local governments and 2.67 billion from local corporations, thanks to the transformation fund (Journal of Small Business and Enterprise Development, 2006, Vol.13, Iss.2, page 242-247).

Since 2001, local governments at different levels have taken active and effective measures to strengthen the transformation and transfer of scientific and technological achievements in agriculture. Special funds have been established in Zhejiang, Beijing, Jiangsu, Jiangxi, and Xiamen. The governments of Guangdong and Shanghai have promised to allocate money for projects that had been allotted transformation fund by the central government. These have promoted the transformation of local scientific and technological achievements in agriculture. Since the launch of the fund, MST and MoF have regularly published call for tendering at the beginning of each year, including application guidelines. After the call for tendering, the S&T

departments in the ministries concerned and provinces will organize the application process. It allows every eligible organization to apply. After passing through the S&T departments' examination and recommendation, applications are then transferred to MST. MST is responsible for application assessment and selection before passing them to an expert evaluation meeting held in conjunction with MoF. Proposals are judged against such criteria as creativity, feasibility, expected outcomes, the applicant's organizational capability, financial status, etc. In the evaluation process, applicants from the western, minority and frontier regions would be considered preferentially. After the expert evaluation meeting, successful proposals are authorized and announced jointly by MST and MoF.

After three years' operation, the fund now has a well-organized operation and management system in place. First, a coordinated and leading team was set up by the Ministry of Science and Technology, in collaboration with the Ministry of Finance, the Ministry of Agriculture, the Ministry of Water Resources, and the State Forestry Bureau. Its task is to coordinate the major issues and to provide instructions concerning the projects. The project management office was set up as a supporting body to the team, taking care of approving projects and managing specific affairs relating to projects.

Second, a mechanism of working meeting was set up. As a routine, all departments are supposed to attend meetings to discuss specific affairs, such as the focus of annual plan, project guidelines, project report to higher authorities, project assessment and approval, project supervision and examination, annual report, etc.

Third, an approval procedure of "two checks, three examinations and one approval" was adopted, that is, the managing departments of science and technology at the levels of province and ministry give the first check to the applications, and the project management office checks the form of the applications; then experts in technology and finance assess projects from the perspectives of technology, market and finance and make recommendations; and finally the leading team decides whether a project should be financed.

Fourth, a well-organized bank of experts was set up to allow random selection to approve projects. Recommended by provinces and ministries, experts become members of the selection team with their information in the database, which covers all subjects and regions. Experts are randomly selected to form a group. Those from one organization and one region are deliberately separated in order to avoid conflict of interest.

Fifth, in project management, attention is not only paid to "entry" but also to supervision. Management regulations have been introduced to set up a standard system of supervision, check, assessment, acceptance and annual report so as to ensure the smooth implementation of the approved projects. It aims at an incorporation of governmental guidelines with social

supervision, which will primarily improve the capital efficiency and ensure the project's successful operation.

Lastly, approved projects are monitored on a regular basis. Ongoing projects are randomly and frequently checked under relevant regulations. In addition, CPA offices, consultancy and assessment centers are invited to check the progression and financial status of the projects. Investigation and analysis show that the transformation of scientific and technological achievements in agriculture plays an essential role in increasing the benefits of agriculture and farmers' income, fostering the adjustment of agricultural structure and speeding up the construction of comparatively well-off villages. In view of difficulties in agricultural technology transfer in China, it is of great practical importance for the government, following the "Green box policy", to put the issue on the top agenda and attract more capital from every walk of society to support the transformation (Journal of Small Business and Enterprise Development, 2006, Vol.13, Iss.2, page 242-247).

## 3.9. A Case of Technology and Market Objectives in the Internationalization of New Technology-Based Firms

In International Small Business Journal, new technology-based firms (NTBFs) setting up in small countries often have to face problems directly related to the size of the country (International Small Business Journal, 1997, Vol.15, Iss.4, page 14-35). Constraints include local supply and demand of technology. Such firms may have to look abroad for technological knowledge and markets that cannot be found locally. The case of a group of Portuguese NTBFs and the conditions that prevailed, leading them to internationalize their activities, is described, based on empirical research.

New technology-based Firms (NTBFs) created in small countries are frequently confronted with a number of problems derived from the size of the country. Two particularly serious constraints regard the local supply and demand of technology. In fact, the national scientific and technological (S&T) structure may only generate a small proportion of the knowledge and technology the NTBFs require to complement their in-house efforts (Perez and Soete, 1988). On the other hand, the local demand for NTBFs' sophisticated products may not be enough to cover development costs or to enable growth (Kim, 1988). If these constraints prevail in small developed countries (Freeman, 1988; Lemola and Lovio, 1988) they assume even greater proportions in less developed ones. Technology-oriented firms operating in a country whose national system of innovation (Lundvall, 1992) is less complete and integrated are likely to be confronted with serious problems with respect to technology access (Perez and Soete, 1988; Walsh, 1987) and particularly to market expansion (Dahlman and Westphal, 1982; Deniozos, 1994). Therefore, NTBFs created in these environments are faced with greater difficulties to

survive and grow as technology-intensive firms (Fontes and Coombs, 1996).

The limitations of the local environment at the level of technology supply and demand may force NTBFs to search abroad for the technological knowledge and the markets they cannot find locally. Studies about small technology intensive firms in less advanced countries, frequently associate success with the ability to internationalize (Ayal and Raban, 1990; O'Doherty, 1990; Valls, 1993)(1). But the process of internationalization is by no means easy for these firms, even if new developments in communications make interaction with distant partners easier (Garnsey and Wilkinson, 1994). NTBFs are young, small firms, with limited resources, both financial and human (Littler and Sweeting, 1990) and a number of `liabilities of newness' with respect to organizational experience and external credibility (Eisenhardt and Schoonhoven, 1990). Moreover, they are often formed by people with a strong technological background but limited competences in non-technological areas (Oakey et al, 1988; Roberts, 1990), which may facilitate technological internationalization but will obviously hinder foreign market expansion. Although these features are shared by NTBFs operating in different environments, NTBFs in advanced economies can more easily compensate for their deficiencies or complement their activities through the establishment of relationships with other organizations (Lawton-Smith et al, 1991; Rizzoni, 1994). Because these organizations are often absent or show lower initiative in less advanced countries (Tsipouri, 1992), NTBFs have to rely much more on their own efforts.

In spite of the importance of foreign technology and markets for the survival and growth of NTBFs created in small countries, these two aspects are rarely addressed simultaneously when their internationalization is considered. On the whole, the literature about the internationalization of small technology intensive firms is scarce and, with rare exceptions (Garnsey and Wilkinson, 1994; Valls, 1993), it either addresses the process of foreign market expansion (Ayal and Raban, 1990; Coviello and Munro, 1995; Lindqvist, 1997) or discusses issues related to foreign technology access (Fourcade, 1993; O'Doherty, 1990; Rothwell and Dodgson, 1989). However, in our view, the two issues are likely to be closely intertwined in NTBFs strategies. The coincidence of technology and market objectives has already been pointed out by other authors as characteristic of small innovative firms' external relationships (Rizzoni, 1994; Rothwell and Dodgson, 1991). Because foreign relationships are more complex to establish and maintain than local ones (Bridgewater, 1992), it is to be expected that this tendency is retained and even magnified, especially when internationalization takes place in a context where access to technology and to markets located outside national borders are parallel preoccupations.

NTBFs are small firms with limited internal resources but substantial technological requirements. Their success in technology acquisition is often associated with the ability to

supplement internal efforts with external technological knowledge and to achieve technological complementarities with other organizations (McGee and Dowling, 1994; Rothwell and Dodgson, 1991). Two main routes were used by the Portuguese NTBFs to establish technology partnerships abroad: (i) through participation on international research projects; (ii) through commercial linkages, with or without a technical component. Only nine NTBFs had already participated in EU-funded research projects. Five were spin-offs from research organizations and the other had good -- although informal -- contacts with the university. Three further firms were planning to submit proposals and two of them were negotiating with larger partners. Subsidiaries of large firms tended to be better equipped to identify the opportunities available and to profit from them: they frequently had one staff member responsible for monitoring ongoing events and for organizing participation, they usually had links with the university and they had resources to co-finance larger projects.

Firms engaging in international projects -- as well as these planning to -- saw participation as strategic for reasons that went beyond the sole technical collaboration. For some firms the research aspect was predominant: the participation in sponsored projects privileging pre-competitive research was seen as the only opportunity to engage in this type of research. It was also seen as a window into the evolution of pre-market technology, especially by firms without the direct channels provided by a close link to a research centre. To some extent these projects represented a defense against peripherality, permitting the access to inputs that NTBFs in more advanced countries might find locally. The financial element was not negligible either, although the synergies achieved through co-operation were considered more relevant. But a basic feature of such participation was that it gave firms visibility to potential partners and credibility in international forums, often regarded as more important than the actual project output. On the other hand, it could also be a first step towards market internationalization, a 'side effect' searched by several firms. A maybe unanticipated outcome was that the actual experience of working together lessened the bias against Portuguese firms, becoming easier for them to be accepted as technology-competent suppliers or partners.

The second route involved securing technology partners on the basis of commercial contacts -- as clients, suppliers or agents. Some relationships with suppliers -- e.g. involving complex inputs that needed to be tailored to the client's needs -- were a good example of this. Starting as mainly commercial relationships, they ended up assuming forms close to technical collaboration. Another interesting case was that of firms which, by venture of their client-supplier relationships with foreign MNEs operating in the Portuguese market, were able to gain contacts abroad, both in the MNE itself and in other firms through its network. But only a few firms had been able to establish partnerships with foreign firms in similar fields. Such achievement was often associated with the NTBF attempt to enter foreign markets, or with the foreign firm's interest in the Portuguese one. Most technological relationships achieved

through the processes described above were largely informal, but firms put some hope on their evolution.

The use of local intermediaries to substitute or complement the firm in the foreign market was based on the assumption that these intermediaries have a better knowledge of the market and easier access to the local clients. It included: (i) use of agents or distributors, whose relationship sometimes evolved to situations of cross-licensing or cross-agency using; (ii) partnerships, entailing participation in the capital of existing firms or creation of new firms; (iii) nonpermanent association with local companies for a particular purpose (e.g. submitting a tender).

Finally, because a number of firms mentioned the role of linkages with market-related complementary assets, this particular case deserves some attention. With very few exceptions, although a relationship was searched, the NTBFs did not favor partnerships with large firms. They were aware of their weaker position and of the chances of being 'swallowed' by the more powerful partner, a situation that is indeed frequent (Lawton-Smith et a4 1991). The example of the few firms which have been able to capitalize on their linkages with larger companies seems to suggest that a preferential but arms-length relationship -- where the small firm is important for the larger one, but does not depend on it -- is the most favorable situation for the NTBF9. One of the reasons why the NTBFs studied found it easier to overcome the difficulties concerning technology access was exactly because they were able to build channels to the sources of the required knowledge and technology, wherever they were located. With time, they became relatively proficient in identifying and accessing the technological inputs relevant for their activities, making the best possible use of the sources available at country level and resorting extensively to foreign ones. As a result, several NTBFs have achieved some degree of technological internationalization, ranging from the establishment of privileged relationships with suppliers of sophisticated inputs, to the integration into the international networks where the tangible and intangible knowledge relevant for their domain circulates.

The degree of integration into international technology networks and the extent to which they became established in foreign markets varied greatly among the firms interviewed. This was related with: (a) their relative need to internationalize; (b) the opportunities open to them in this area -- particularly evident with respect to the market, with some firms being confined to the national market or constrained in their internationalization efforts by the nature of their local clients' demand; (c) their ability to achieve it -- firms had diverse resource levels, adopted different strategies and were more or less able to obtain externally the assistance and/or complementarities that could leverage their individual efforts. The results presented in this paper can be seen as preliminary, being based on a relatively small sub-sample of

Portuguese NTBFs. The methodology adopted permitted an in-depth analysis of the strategies and practices of the firms interviewed which resulted in the identification of important aspects of NTBFs' behavior in this area. But the conclusions reached should now be tested upon the wider population of internationalized or 'internationalizing' Portuguese NTBFs. Also, it would be interesting to return to the NTBFs studied and examine the evolution registered in their strategies, as well as the outcome of their then very preliminary efforts with respect to market internationalization.

The conclusions reached are, to some extent, consistent with these of other studies about NTBFs' internationalization behavior. But they also call the attention to the particular problems and bottlenecks of NTBFs originating from a less advanced country, both these related to their local environment and these deriving from their attempts at moving beyond the national constraints. These conclusions may therefore be useful to other countries (especially European countries, whether or not part of the EU) in a similar economic situation. Further research in such contexts is necessary in order to identify common problems and eventually provide the basis for common policies (International Small Business Journal, 1997, Vol.15, Iss.4, page 14-35).

## 3.10. A Case of Market versus Corporate Structure in Plant-level Innovation Performance

In Small Business Economics, a study examines the effect which market and corporate structure have on the extent of innovation for a sample of circa 300 manufacturing plants located in Scotland (Small Business Economics, 1999, Vol.13, Iss.2, page 97-109). Innovation is defined as the introduction of a commercially significant new product at the establishment level. The theoretical model of Geroski (1990) is extended to incorporate plant-level variables such as size, multiplant operation, the presence of R&D facilities and external/indigenous ownership. A distinction is made between the direct and indirect effects of these variables. Negative binomial estimations indicate that corporate structure influences are more important in determining the number of innovations than market structure and barrier to entry variables. Plant size, foreign ownership and the presence of R&D are all positively associated with innovation. Direct effects greatly outweigh indirect effects. Tobit estimations on the number of innovations per employee support the findings of Acs and Audretsch (1988) that smaller enterprises are more innovation intensive than larger enterprises, at least up to a limit of around 1200 employees. The positive effect of R&D arises principally from increasing the probability of a plant becoming an innovator, rather than from making a plant more innovation intensive. By contrast, the importance of size lies principally in encouraging further innovations among plants which are already innovators, but less than proportionately with the increase in employment size.

There is now a substantial economics literature which examines the factors determining innovation, with particular emphasis being placed on the role of market power (e.g. Kamien and Schwartz, 1982; Levin et al., 1985), and on establishment size (Acs and Audretsch, 1988; Brouwer and Kleinknecht, 1996). A second strand of literature examines the link between corporate ownership structure and innovation, but with little attempt to model formally the relationship, or to see these factors in the context of more general economic determinants of innovation (e.g. Oakey et al., 1980; Goddard et al., 1986). This study attempts to bring together these two elements, and to add to them in three distinct ways. First, instead of the industry analysis often employed in the industrial organization literature, we employ establishment-level data within a clear theoretical framework. This allows a closer analysis of how elements of corporate structure affect innovation than is permitted by industry-level analysis. Secondly, instead of regarding innovation in simple dichotomous terms (i.e. whether or not firms innovate), this paper examines the determinants of the extent of innovation, thus allowing for the fact that while many firms do not innovate, some innovate a great deal. Finally, we explicitly distinguish between the direct and indirect effects of the explanatory variables on innovation; that is between the effect which is not mediated through post-innovation profits, but arises for any given level of post-innovation profitability (the direct effect) and that effect which occurs via the impact which the explanatory variables have on the size of post-innovation returns (the indirect effect). This distinction has rarely been made in the literature on innovation (Small Business Economics, 1999, Vol.13, Iss.2, page 97-109).

There are several specific firm and plant-level characteristics repeatedly identified in the literature as being important for innovation. These include establishment size, multiplant operation, the nature of the ownership and control of local establishments, and the related presence or absence of key functions such as R&D. The direct and indirect effects of these variables are generally implicitly conflated in the regional economics literature. For example, Oakey et al. (1988) suggest several Schumpeterian reasons why large firms may be more innovative than small firms. Large firms will probably experience scale sensitive advantages in R&D itself and will also benefit from non-technological, scale-intensive activities which support innovation, such as production, marketing and finance: such firms will also be better able to finance a range of innovative projects, allowing them to spread risk. These may be characterized as indirect effects of scale, which act to raise the post-innovation price-cost margins of larger firms. But Oakey et al. also note more direct advantages of scale, such as greater division of labor permitting the maintenance of specialized departments such as patenting and specialist libraries. The ability to maintain contacts with external organizations will also increase with size if pressure on management time in smaller firms leaves little room for this. This is supported by Freeman (1982), who notes that one of the factors which discriminated between success and failure was the ability to maintain contact with specialized centers of excellence.

The effects of multiplant operation and external control are highly interlinked, and there is no attempt in the literature to distinguish between direct and indirect effects. For example, Thwaites (1978) suggests some grounds for belief in a positive association between external control and innovation, particularly in the context of "mobile plants", i.e. those which were encouraged to move to the peripheral areas (of the U.K.) because in situ growth was constrained by legislation prohibiting expansion in the South East. In the first instance, such plants will have been part of a growing firm and probably a growing industry, with the possibility that the propulsive force behind growth was innovation. Secondly, externally-owned plants are, in the majority of cases, part of larger commercial organizations, and they may therefore gain by access to the parent's resources. Such resources may be technological, for example, access to larger scale R&D facilities operated by the parent, or to proprietary knowledge developed by the parent (Oakey, 1979; Brugger and Stuckey, 1987). Branch plants may also benefit from contacts with external research establishments maintained by the parent, or they may be the direct recipients of innovations developed elsewhere in the group. Alternatively, access may be available to a wide range of non-scientific resources such as finance, a national or international marketing organization through which new products can be diffused, patenting and other support functions. Finally, branch plants may be of a sufficient size to support innovation because of the market area served and, in particular, may be larger than indigenous counterparts.

The results of the empirical analysis indicate that, when set within a formal model of the determinants of innovation, these factors are indeed of some importance. Large plants have more innovations, but fewer innovations per employee, at least until some limit. The importance of size lies principally in encouraging further innovations among plants which are already innovators. However, this may not be a simple linear relationship. The results of size on both number of innovations and innovations per employee suggest that larger size does encourage more innovations, but less than proportionately with the increase in employment up to a limit of c.1200 employees; thereafter, the increase in innovations induced by increasing size is more than proportionate. Because plants with more than 1000 employees represent a tiny fraction (0.5%) of manufacturing plants in Scotland,10 for most practical purposes smaller plants are indeed more "innovation intensive" than their larger counterparts. By contrast, the presence of R&D and, to some extent, foreign ownership helps firms to become innovators, but does little to increase the number of innovations among innovating plants. R&D, but not foreign ownership, also helps to increase innovations per employee.

Finally, the results suggest that, although the profits proxy is imperfect, direct effects are the dominant element of the overall effects of corporate structure influences on innovation. One implication of these findings is that contrary to the hypotheses developed in much of the literature - external control is not necessarily inimical to innovation within the manufacturing

sector of the regional Scottish economy. Indeed, there is a slight positive effect of foreign ownership, although not of intra-U.K. ownership. However, this is critically linked to the R&D issue, where it is clear that plant-level facilities are of great importance in making a plant an innovator, but play a much less important role in enhancing innovativeness once the initial threshold has been overcome. Since externally owned branch plants are less likely to have in-house R&D facilities than their indigenous counterparts, this conclusion supports the suggestion of Ashcroft et al. (1995) that policy initiatives to encourage inward investing multinationals to set up research facilities in Scotland would be worthwhile.

Such an initiative would, however, do nothing to encourage innovation among indigenous concerns, which must be the principal concern of government. Given the relative innovation-intensiveness of smaller plants, it would appear that the U.K.'s policy stance of providing innovation support mainly for SMEs is sensible. However, recent research by the present authors and colleagues (Roper et al., 1996) suggests that U.K. firms are less likely to innovate than their German counterparts, and Scottish-based firms particularly unlikely to do so. The key, therefore, would appear to be finding some method of helping smaller indigenous concerns overcome the hurdle of the initial innovation.

## 4. Focal Points of Policy making for successful R&BD Programs

One of the focal points of policy making for successful R&BD programs is to get the benefits out of the programs. Expected benefits which trainees may receive by learning this subject will be as follows:

- Trainees will have an idea that R&BD (Research & Business Development) is more focused on the commercialization and marketing which generate funds for the reinvestment and on-going enterprises.
- This is the reasons why R&BD can be a course suitable for SME innovation policy training
- R&BD is the fruit (result) of SME innovation.
- Trainees will have knowledge how R&BD can transform an innovative product that can meet market needs and customer satisfaction. Trainees are also can study about customer culture and environment to avoid failure in meeting market needs.
- Trainees will have an idea about organizing an effective and efficiency R&BD programs for SMEs in order to minimize risk management. It includes cost management, human resource management, and time management.
- Trainees will have knowledge in increasing innovation for SMEs to drive the competitive advantage.

- Trainees will know that R&BD can help SMEs to survive from the business competition for a long term.
- Trainees can support SMEs in analyzing the appropriate technology to produce the innovative product.
- Trainees will have ability to analyze the problem in R&BD for SMEs and try to solve that problem properly.
- Trainees will have ability in guiding the R&BD for SMEs to ensure consistency in decision making to ensure the correct focus on customer (market) requirements.

To create competitive success today demands business-building programs in which technologies generated in the lab are rapidly converted into deployable capabilities and speedily commercialized and diffused into new markets. The leader of a technology development program, therefore, needs to assume a much more comprehensive and integrative role than the traditional R&D manager. Its executives start by seeking to identify unmet medical needs, and then they focus on opportunities that are scientifically and technologically feasible.

If we add how workshop participants may utilize the training materials about a specific subject to make their own policy prototype, we can insist that the workshop will provide participants with the idea for the actual implementation of participants' R&BD programs among APEC region. Other focal points of policy making for successful R&BD programs is to change the SMEs CEO mind from simple engineering mind to business mind through the innovation education by government.

## 5. Discussion Points: Sharing ideas among APEC members

The reason why R&BD (Research & Business Development) became one of the training courses suitable for SME innovation policy training is that R&BD is more focused on the commercialization and marketing which generate funds for the reinvestment and on-going enterprises. In order to make the program successful participants may share their ideas including the following discussion points:

- How did your economy establish R&BD program in your own environment?
- What kind of problems can you expect in your economy?
- How did your government support the program such as funds, risk management, etc?
- What is the first step you can choose to implement R&BD program?
- How does the cooperation work among SMEs, government, research centers and universities?
- How does the innovative product can meet the market needs? What is the best

solution if the innovative product failed to meet the market needs?

- In R&BD human resource management, which one is better for SMEs between external recruitment of experienced staff or training staff internally?
- Does the increase of market change can affect the increase of innovation?
- Does the effective innovation program can result competitive advantage?
- What are the success and failure factors for such interventions and resultant innovation effectiveness in SMEs?
- How could SMEs manage innovation effectively and efficiently through optimizing organizational structure?
- The small enterprises have made and continue to make a critical contribution to the market economies' unprecedented growth and innovation accomplishments. Is it true that small enterprises critically have a better idea for innovation than the large companies?
- Some of the enterprises consider the outsourcing for R&D activities, because of some enterprises do not have a good capability and experience in R&D activities. Is that issue having a positive impact to the enterprises' performance, especially for small enterprises?
- An enterprise which creates an innovative product for the market needs must move on quickly to create another innovative product, because there will be many other companies are following those innovation that has been created. Therefore, they are both the leader and the follower, and sometimes the follower creates a differentiation from that innovative product. Is there any strategy to avoid this issue?
- Is there any solution to reduce that R&BD cost since the cost of R&BD activities is very expensive? Or is it possible that one enterprise is sharing R&BD activities with other enterprise when they have a similar concept of innovation in order to reduce R&BD cost for each other and become a win-win solution for both of those companies.
- How could you help SMEs create one consistent perception in the cooperation among R&BD, Marketing, and Manufacturing divisions? Those three divisions are always get involved in innovation strategy, but sometimes all of them might have the different perceptions.
- Small firms have been rated lower in the ability and efforts on a number of possible indicators for new product market visioning than the larger firms. How could you help SMEs overcome the gaps?
- Development processes are identified to satisfy the needs of new customers using their current technologies. However, managers need to empower cross-functional teams to evaluate new technologies with an ever-increasing number of pioneering partners in order to sustain the R&BD activity. How could you help SMEs sustain

the R&BD activity?

- Technology transfers in agriculture play an essential role in increasing agricultural productivity as well as farmers' income, fostering agricultural re-structuring, and speeding up the construction of comparatively well-off villages. Is it a great practical importance for the government to put the issue on the top agenda and attract more capital from every walk of society to support the ongoing transformation?
- The process of innovation in organizations covers people, process and technology. Therefore interventions in the form of innovation improvement programs often require high levels of complexity. This complexity is compounded in SMEs, where issues such as scarce resources and skill shortages must be recognized. How could you help SMEs overcome the complexity?
- SMEs, which have high levels of innovation improvement, adopted a broad process-based approach to innovation rather than using a narrow technical definition of innovation. These SMEs also developed a process of critically reflective action learning to ground the innovation in organizational practice. How could you help SMEs improve the innovation?

## 6. Conclusions

R&BD (Research and Business Development) that is next generation R&D strategy that focuses on business-related R&D to provide sustainable benefits for SMEs (Small and Medium Enterprises), while SMEs consider the business or marketing strategy from the early stage of R&D.

There are some conclusions that have been made based on the Research and Business Development theory and case studies:

- Small firm owners, who are highly innovative in a specific domain, may adopt innovations without clear information about its market acceptance. Market-oriented small firms copy the successful innovations once customer market intelligence becomes available. Moreover, customer market intelligence stimulates small firms that would otherwise lag behind in innovation. Consequently, the innovativeness of small firm owners is a crucial asset, which stakeholders of an industry such as governments and suppliers should cherish. Restrictions on innovativeness, via legislation, or conservative financing may propel entrepreneurial owners of small firms out of an industry, which will deteriorate its competitive position. (Journal of Small Business Management, 2004, Vol.42, Iss.2, page 134-154)
- There are seven items, which are postulated to contribute to a better understanding

of the contexts encouraging or discouraging new product market visioning. Those seven items are as follows :

- Feasibility audit of new products in the marketplace
- Understanding of what products will be demanded in two years period
- Understanding of what products will be demanded in five years period
- Understanding of our potential for developing new products
- Ability to predict our customers' reaction to our new products
- Regular monitoring of the success of our different product ranges
- Critical review of our portfolio of products in the past year

It is understood that smaller firms are more innovative than larger firms. However, innovativeness itself does not necessarily lead to better market visioning of new products. To nurture fertile contexts for new product market visioning, a small firm has to do proper review, audit and whatever is needed in order to have a systematic and comprehensive understanding of where they are and where they can go. Without all this homework, a smaller firm may still be able to launch new products, some of which could be successful. Yet this is more of a hit-and-miss style and therefore results in an unnecessary waste of resources. On the other hand, with appropriate efforts on nurturing the contexts for new product market visioning, coupled with the innovativeness of small firms because of their flexibility and less rigid organizational structure, they can stand a higher chance to achieve an impressive rate of conversion from opportunity product concepts to successful product concepts. (Journal of Small Business and Enterprise Development, 2007, Vol.14, Iss.1, page 81-92)

- The transformation of scientific and technological achievements in agriculture plays an essential role in increasing the benefits of agriculture and farmers' income, fostering the adjustment of agricultural structure and speeding up the construction of comparatively well-off villages. (Journal of Small Business and Enterprise Development, 2006, Vol.13, Iss.2, page 242-247)
- The drivers of innovation in small manufacturing firms are: culture, leadership, process innovation and company strategic orientation. Innovation activities consist of developing new ways of working and incremental product innovations. SMEs have advantages over large firms such as being close to customers, a flexible and informal environment. Additionally, they have a risk-taking attitude and welcome

change in particular in relation to new ways of working. SMEs' main drawbacks are customer dependency, lack of knowledge and skills, training, networking as well as lack of financial resources. (Journal of Small Business and Enterprise Development, 2006, Vol.13, Iss.3, page 363-380)

- Innovation is a broad concept involving people, process and technology and studies must be careful of organizational concepts based solely on technical innovation. Innovation studies in SMEs must be highly contextualized, where SMEs are treated as a phenomenon in their own right rather than scalar versions of large organizations. Treating innovation as a process within the SME context has merit as a basis for such studies provided the wider definition of innovation is used rather than being limited to that of technical issues. Using this process, the SME's were able to more readily incorporate and link people, process and technology aspects of innovation in a progressive manner. The process of innovation within SMEs as aided by learning interventions can be studied using Critical Action Learning, where resource and skills limitations for learning by rote can be addressed. (Journal of Small Business and Enterprise Development, 2007, Vol.14, Iss.3, page 385-403)
- The challenges for the technology development manager can be perceived in terms of nine major roles, encompassing the major sets of activities (pipeline-building, market entry and takeoff) attacked at three levels of challenge (venturing, championing and heat-shielding). [Research Technology Management, 2004, Vol.47, Iss.3, page 16-26]

Finally, participants are supposed to make innovation-oriented SMEs sustainable with the sufficient amount of profit and to help them establish the business-oriented strategy from the early stage of R&D with practical governmental policies. R&BD is a critical part for SMEs' development in the APEC member economies.

## 7. References

Ashcroft, B., S. Dunlop and J. H. Love, "U.K. Innovation Policy: A Critique," Regional Studies 29, 307-311, 1995

Audretsch, David B., Albert N. Link and John T. Scott, "Statistical Analysis of the National Academy of Sciences Survey of SBIR Awardees: Analyzing the Influence of the Fast Track Program," in Charles Wessner (ed.), The Small Business Innovation Research Program (SBIR): An Assessment of the Department of Defense Fast Track Initiative, Washington, D.C.: National Academy Press, pp. 275-290, 2001

Ayal, I., and Raban, J., “Developing Hi-tech Industrial Products for World Markets,” IEEE Transactions on Engineering Management, 37(3): pp177-183, 1990

Bridgewater, S., “Informal Networks as a Vehicle for International Market Entry: Future Research Directions,” British Academy of Management Conference Management into the 21st Century', Bradford, September, 1992

Brouwer, E. and A. Kleinknecht, “Firm Size, Small Business Presence and Sales of Innovative Products: A Micro-econometric Analysis,” Small Business Economics 8, 189-201, 1996

Brugger, E. A. and B. Stuckey, “Regional Economic Structure and Innovative Behaviour in Switzerland,” Regional Studies 21, 241-254, 1987

Carson, D., S. Cromie, P. McGowan, and J. Hill., “Marketing and Entrepreneurship in SMEs: An Innovative Approach,” London, UK: Prentice Hall, 1995

Coviello, N. E., and Munro, H. J, “Growing the Entrepreneurial Firm. Networking for International Market Development,” European Journal of Marketing, 27(7): pp49-61, 1995

Crawford, M., “New Product Management,” 7th ed., McGraw-Hill, Boston, MA, 2003

Dahlman, C., and Westphal, L., “Technological Effort in Industrial Development -- An Interpretative Survey of Recent Research,” in Stewart, F., and James, J. (eds.), The Economics of New Technology in Developing Countries, London: Frances Pinter, pp105-l37, 1982

Deniozos, D., “Steps for the Introduction of Technology Management in Developing Economies: The Role of Public Governments,” Technovation, 14(3): pp197-203, 1994

Eisenhardt, K M., and Bird Schoonhoven, C., “Organisational Growth: Linking Founding Team, Strategy, Environment and Growth Among US Semiconductor Ventures, 1978-1988,” Administrative Science Quarterly, Vol. 35, pp504-529, 1990

Feldman, Maryann P., “Role of the Department of Defense in Building Biotech Expertise,” in Charles Wessner (ed.), The Small Business Innovation Research Program (SBIR): An Assessment of the Department of Defense Fast Track Initiative, Washington, D.C.: National Academy Press, pp. 251-274, 2001

Fourcade, C., “Networking Strategies for Small Firms Coping with Globalisation,” in Humbert, M. (ed.), The Impact of Globalisation on Europe's Firms and Industries, London: Pinter Publishers, pp2l2-2l7, 1993

Freeman, C., “Technological Gaps, International Trade and the Problems of Smaller and Less Developed Economies,” in Freeman, C., and Lundvall, B. (eds.), Small Countries Facing the Technological Revolution, London: Pinter Publishers, pp67-84, 1988

Freeman, C., “The Economics of Industrial Innovation,” 2nd Ed., London: Frances Pinter, 1982

Garnsey, E., and Wilkinson, M., “Global Alliance in High Technology: A Trap for the Unwary,” Long Range Planing, 27(6): pp137-146, 1994

Geroski, P., “Innovation, Technological Opportunity, and Market Structure,” Oxford Economic Papers 42, 586-602, 1990

Goddard, J., A. T. Thwaites and D. Gibbs, “The Regional Dimension to Technological Change in Great Britain,” in Amin, A. and J. B. Goddard (eds.), Technological Change, Industrial Restructuring and Regional Development, London: Allen and Unwin, 1986

Hakon Finne, , Morten Levin and Tore Nilssen, Trailing Research: A Model For Useful Program Evaluation, Evaluation(SAGE Publication), 1995

http://www.edaily.co.kr/news/industry

http://www.sba.gov/SBIR

http://www.yujinrobot.com

Hyung-Ji Jung and Dae-Soon Hong, “Beyond the 3rd Generation R&D,” Kyung-Duck Press, January, 2007 (Written in Korean)

Jan Norman, “What No One Ever Tells You about Starting Your Own Business: Real-Life Start-Up Advice from 101 Successful Entrepreneurs,” Kaplan Business, 2nd edition, July 1, 2004

Jane Applegate, “201 Great Ideas for Your Small Business: Revised & Updated Edition,” Bloomberg Press; 2 edition , June 15, 2002

Jung-il Kim, “Policies for Promoting Innovation-oriented SMEs in Korea,” KDI 36th Anniversary International Conference On “Financing Innovation-Oriented Businesses to Promote Entrepreneurship: Experiences of Advanced Countries and Lessons to Korea,” April 26, 2007

Kahn, K.B., “An exploratory investigation of new product forecasting practices,” Journal of Product Innovation Management, Vol. 19, pp. 133-43, 1992

Kim, L., “Entrepreneurship and Innovation in a Rapidly Developing Country,” Journal of Development Planning, 18: pp183-194, 1988

Kirton, M., “Adaption and Innovation: A Description and Measure,” Journal of Applied Psychology 61(5), 622–629, 1976

Lawton Smith, H., Dickson, K., and Lloyd Smith, S., "There Are Two Sides to Every Story: Innovation and Collaboration Within Networks of Large and Small Firms,” Research Policy, 20:pp457-468, 1991

Lemola, T., and Lovio, R., “Possibilities for a Small Country in High-technology Production: The Electronics Industry in Finland,” in Freeman, C., and Lundvall, B. (eds.), “Small Countries Facing the Technological Revolution,” London: Pinter Publishers, pp139-155, 1988

Lerner, Joshua and Colin Kegler, “Evaluating the Small Business Innovation Research Program: A Literature Review,” in Charles Wessner (ed.), “The Small Business Innovation Research Program (SBIR): An Assessment of the Department of Defense Fast Track Initiative,” Washington, D.C.: National Academy Press, pp. 397-426, 2001

Levin, R., W. Cohen and D. Mowery, “R&D Appropriability, Opportunity, and Market Structure: New Evidence on the Schumpeterian Hypothesis,” American Economic Review 75, 20-24, 1985

Lindqvist, M., “Infant Multinationals. Internationalisation of Small, Technology-based Firms,” in Klofsten, M., and Jones-Evans, D. (eds.), “Technology, Innovation and Enterprise -- The European Experience,” Macmillan (forthcoming), 1997

Link, Albert N. and John T. Scott, “Estimates of the Social Returns to Small Business Innovation Research Projects,” in Charles Wessner (ed.), The Small Business Innovation Research Program (SBIR): An Assessment of the Department of Defense Fast Track Initiative, Washington, D.C.: National Academy Press, pp. 275-290, 2001

Link, Albert N., “An Assessment of the Small Business Innovation Research Fast Track Program in the Southeastern States,” in Charles Wessner (ed.), The Small Business Innovation Research Program (SBIR): An Assessment of the Department of Defense Fast Track Initiative, Washington, D.C.: National Academy Press, pp. 194-210, 2001

Littler, D., and Sweeting, R. C., “The Management of New Technology-based Businesses:

The Existentialist Firm," Omega, 18(3): pp231-240, 1990

Lothar Katz, "Negotiating International Business: The Negotiator's Reference Guide to 50 Countries Around the World," BookSurge Publishing, December 22, 2006

Lundvall, B. (ed.), "National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning," London: Pinter Publishers, 1992

McGee, J. E., and Dowling, M. J., "Using R&D Co-operative Arrangement to Leverage Managerial Experience: A Study of Technology-intensive New Ventures," Journal of Business Venturing, 9: pp33-48. Miles, M. B., and Huberman, A. M. 1984, Qualitative Data Analysis, Newbury Park: Sage, 1994

Miller, William L. and Morris, Langdon, "Fourth Generation R&D," John Wiley & Sons Inc, 1999

Ministry of Industry and Energy, "Northeast Asia R&BD hub Construction," Propulsion, 2005

Nooteboom, B., "Innovation and Diffusion in Small Firms: Theory and Evidence," Small Business Economics 6(4), 327–347, 1994

Oakey, R. P., "Technological Change and Regional Development: A Note on Policy Implications," Area 11, 340-344, 1979

Oakey, R. P., A. T. Thwaites and P. A. Nash, "The Regional Distribution of Innovative Manufacturing Establishments in Britain," Regional Studies 14, 235-253, 1980

Oakey, R. P., Rothwell, R. and Cooper, S., "The Management of Innovation in High-technology Small Firms -- Innovation and Regional Development in Britain and the United States," London: Pinter Publishers, 1988

O'Doherty, D., "Strategic Alliances -- an SME and Small Economy Perspective," Science and Public Policy, 17(5): pp303-3l0, 1990

Pelham, A. M., "Market Orientation and Other Potential Influences on Performance in Small and Medium- Sized Manufacturing Firms," Journal of Small Business Management 38(1), 48–67, 2000

Rizzoni, A., "Technology, and Organisation in Small Firms: An Interpretative Framework," Revue d'Economie Industrielle, 67: pp135-155, 1994

Roberts, E. B., “Evolting Towards Product and Market Orientation: The Early Years of Technology-based Firms,” Journal of Product Innovation Management, 7(4): pp27 287, 1990

Roper, S., B. Ashcroft, J. H. Love, S. Dunlop, H. Hofmann and K. Vogler-Ludwig, “Product Innovation and Development in U.K., German and Irish Manufacturing,” Belfast: Queen's University of Belfast/University of Strathclyde, 1996

Rothwell, R., and Dodgson, M., “External Linkages and in Small and Medium-sized Enterprises,” R&D Management, 21(2): pp125-137, 1991

Rothwell, R. and Dodgson, M., “Technology-based Small and Medium-sized Firms in Europe: The IRDAC Results and their Public Policy Implications,” Science and Public Policy, 16(1): pp9-18, 1991

Ruekert, R. W., “Developing a Market Orientation: An Organizational Strategy Perspective,” International Journal of Research in Marketing 9(3), 225–245, 1992

Sbirworld.Com, General SBIR Overview, 2006

Scott, John T., “An Assessment of the Small Business Innovation Research Program in New England: Fast Track Compared with Non-Fast Track Projects,” in Charles Wessner (ed.), The Small Business Innovation Research Program (SBIR): An Assessment of the Department of Defense Fast Track Initiative, Washington, D.C.: National Academy Press, pp. 104-140, 1991

Sivadas, E. and F. R. Dwyer, “An Examination of Organizational Factors Influencing New Product Success in Internal and Alliance-Based Processes,” Journal of Marketing 64(1), 31–49, 2000

Smallbone, D., and D. North, “Innovation and New Technology in Rural Small and Medium-Sized Enterprises: Some Policy Issues,” Environment and Planning C: Government and Policy 17(5), 549–566, 1999

Steven D. Strauss, “The Small Business Bible: Everything You Need To Know To Succeed In Your Small Business,” Wiley, December 15, 2004

The homepage of Small Business Development Center in US Small Business Administration (http://www.sba.gov/aboutsba/sbaprograms/sbdc/index.html)

The homepage of Small Business Research Initiative in United Kingdom (http://www.dti.gov.uk/innovation/sbri/index.html)

The homepage of The Asia Foundation Experience in Indonesia (http://www.asiafoundation.org/pdf/indo_SME.pdf)

The homepage of The Wharton Small Business Development Center in Pennsylvania (http://whartonsbdc.wharton.upenn.edu/aboutus.html)

Traill and K. G. Grunert. London, UK: Blackie Academic & Professional, 213–226.

Tsipouri, L.; “Evaluating the Economic Effects of R&D in Less Favored Countries: The Notion of Complementarity,” Research Evaluation, 2(1): pp27-35, 1992

Valls, J., “Small Firms Facing Globalisation in R&D Activities. Lessons from Case Studies of Spanish Small Firms,” in Humbert, M. (ed.), The Impact of Globalisation on Europe's Firms and Industries, London: Pinter Publishers, pp200-2l0, 1993

Wynarczyk, P., “The economic success of UK innovative small firms,” paper presented at the 1997 42nd World Conference of International Council for Small Business, San Francisco, CA, 1997

Zachariasse, L.C. Boer en Bedrijfsresultaat: Analyse van de Uiteenlopende Rentabiliteit van Vergelijkbare Akkerbouwbedrijven in de Noord-Oost-Polder. [Farmer and Farm Returns: An Analysis of Causes of Differences in Profitability of Similar Arable Farms in the North-East-Polder].Wageningen, The Netherlands: Landbouwhogeschool, 1974