Innovative Knowledge Networks as a competitive powerhouse; Best practices of the "eNET Services" in Hsinchu Science Park-Taiwan

Ching-Ming Hwang, Wen-Hsiung Huang, How-Gao Hsu, Yin-Lin Tsai,
Hsinchu Science Park-Taiwan

Abstract

This paper exposes the best practices in the case for why Hsinchu Science Park（HSP）in Taiwan provides tools for building the park more creative, productive, and efficient by applying principles of creative collaboration, knowledge sharing, and social networking. HSP introduces a powerful new concept – Innovative Knowledge Networks, or "eNET Services". The services system is a value-added networks with a collective vision enabled by technology to collaborate in achieving an innovation by knowledge sharing and work virtually in park community.

Hsinchu Science Park Administration（HSPA）provides the services that response the present and future needs of the company in the park. The eNet Services system is the most power engines of innovation ever and has found its wide application on park administration affairs. The eNet Services will create the best innovative networks transforming HSP to become competitive knowledge powerhouse of the world.

1. Introduction

To face the challenges of the world competition, the best way to gain power is to shift our central thinking from commanding and controlling into coordinating, cultivating and sharing in knowledge economy and network society. Pursuing efficiency, cost-saving, and performance is reckoned as the first priority for offering knowledge-based high-tech industries the world-class services. With dramatic changes of modern high-tech industries and revolution of internet and telecommunication related technologies, government services are subject to make proper adjustment to meet demands from high-tech enterprises. This paper exposes the best practices in the case for why Hsinchu Science Park（HSP）in Taiwan provides tools for building the park that are more creative, productive, and efficient by applying principles of creative collaboration, knowledge sharing, and social networking. Hsinchu Science Park introduces a powerful new concept – Innovative Knowledge Networks, or "eNET Services". The eNET Services is a value-added networks with a collective vision enabled by technology to collaborate in achieving an innovation by sharing ideas, information, and work virtually in Hsinchu science Park community. Hsinchu Science Park Administration（HSPA） provides the services that response the present and future needs of the company in the park. It is no exaggeration to state that "eNET Services" are the most power engines of innovation ever.

Case study of development of the Hsinchu Science Park over the years has effectively brought upon elevation of domestic high-tech industry besides impacting on regional economic development. High-tech industry acts as a driving force in boosting Taiwan's economic development in recent years. Through the efforts dedicated by both the government and private sectors, high-tech industry has founded a solid base in extending Taiwan's high-tech industry competence, with a strong base for promising future development. Over decades of endeavor, high-tech industry has achieved outstanding success, bringing numerous economic "miracles" to the island in southeastern Asia. Hsinchu Science Park has established to introduce high-tech industries and attract talent to Taiwan, promote the upgrading of Taiwanese industries, balance regional development and drive national economic development. Since the Hsinchu Science Park was established in December 1980, the government has

invested US$1,679 million on park infrastructure and facilities. During its 25 year history, the Hsinchu Science Park has focused both on research and production, thus profoundly impacting the local economic development and giving the Hsinchu Science Park an international reputation and establishing it as a model imitated by other countries. Today the Park is not merely a high-tech industry cluster but also a knowledge innovation powerhouse. Knowledge-based economic model has brought upon global economic structural changes and social norm adjustment. Business globalization and global labor diversification have put forward to a multiple competition of human resources, materials, capital, and technology, where lower labor production cost and cheaper land renders Mainland China as a global factor. Facing this giant change of global economic structure, Taiwan is standing on a transitional point where existent high-tech industry operation model is encountering to a dramatic change. Industry structure as well as administrative services have thus to be adjusted in order to meet coming challenges of globalization and competition.

As revealed in the SOC/RATE project of the European Thematic Network of Education and Training (ETNET21) by Andre Vander Beken in 2002-2003, R&D and innovation networks have grasped solid foundation of conceptual social model. As a mirror of the project, endeavors of the Hsinchu Science Park in fostering R&D resources, high-tech professional training, and human resources cultivation have solidified prospects of “3e Park”, namely ecological, economic, and electronic, to enhance the innovation network of high added values platform. R&D encouragement and exciting programs driven by the Hsinchu Science Park Administration, such as SBIR, professional training programs facilitated by academic sectors under commission mechanism, e-learning mechanism, and innovation elevation mechanism have effectively promoted the innovation competence of the Hsinchu Science Park. Related administrative services, such as e-commerce, e-government, etc., have effectively integrated administrative networks of different parks derived by the Hsinchu Science Park Administration.

To provide an efficient administrative service among different management platforms and to integrate innovation service network among different extended satellite science parks of the Hsinchu Science Park, the Park Administration has been eagerly endeavored to elevate information integration and service quality, in order to pursue a solid administrative service platform and innovation network. Key issues fostering transformation of the Hsinchu Science Park lies in superior administrative services as well as integrated innovation networks. Utilization of electronic tools put an add to the overall service performance. In addition to service enhancement and R&D competence of the Hsinchu Science Park, the Park Administration also seeks an eager interaction with global high-tech community in terms of global strategic alliances and collaborative partnership establishment, where low intensity networks, e.g. forum, platform, and alliance, have gradually extended to higher intensity networks, e.g. cluster, partnership, and consortium, with this “Innovative Knowledge Networks” and service orientated management model as a competitive powerhouse to step into new era of the Hsinchu Science Park. Technology innovation of Internet brings revolution in information and telecommunications technologies, which accordingly plays a crucial role in piloting national high-tech industry development. To cope with global high-tech industry development trend in reaching the goal of rendering a high-quality and efficient investment environment for high-tech and knowledge-based industries, impact of information and telecommunications technologies on high-tech industry development has to be taken into serious account. European countries, the United States and Japan have each launched programs to build a "national information infrastructure" (NII) to enhance their national competitiveness. Responding to this trend, the government in Taiwan has worked closely with private sectors to establish a beneficial environment to solidify domestic high-tech industry development environment. To cope with government’s policies, the Hsinchu Science Park has eagerly carried out eNet and e-government related services systems, in an eye to provide Park tenants superior administrative services.

2. Related Studies: Knowledge Networks

As a global trend, eNet services as well as e administration have attracted a wide attention in recent years.

Related Studies in these fields have been discussed in the Science Park Organizations. such as IASP and ASPA . Brown, Ho and Peters,（2005）indicated the networking and "networkers" in the SP's innovation system. There are many dimensions of global networking within and among science parks, including the flows of capital, information, knowledge and ideas, technology, R&D, people and distribution chain, supply chain, business network. Luis Sanz state that a new methodology - strategigram to deepen our understanding the strategic position of SPs (Luis Sanz, 2005). The strategigram based on the six strategic axes may provide the position for Networking between parks. The strategic axes include: location, position in the technology stream, target firms, technology fields, target markets and governance. The different strategigram curve show the dynamic growth energy of SP, and the potential mission direction SP might orient, after comparison with the strategigram of other SPs around world.

The significance of networks and networking has figured prominently over many years in the policies and programes of the European Commission in support of innovation (European Commission, 2004). The networks and networking, providing the social relationship to facilitate the processes of transfer, flow, linking and engagement, have been accepted widely as the characteristics of SPs. It is also important to emphasize on active organization, management or orchestration of these processes to handle knowledge, technology and skills. The development of ICTs provides new models of internal and external networking. However, the co-operation depends on more than technology, companies must have the will to use collaborative practices in proactive ways. In a recent report on innovation management and the knowledge economy (European Commission, 2004), cooperative and networking techniques are discussed. The report distinguishes among "communication", "coordination" of actions, and full "collaboration", both within and among organizations or SPs. For networking, there are methods could be used, such as supply chain management systems; industrial clustering; intranet, extranets; mailing and news sharing; partnership with universities and research centers. The most important challenges for current science parks is to promote a world calss networking platform not only virtually through ICT, but also physically, for all people, companies or institutions related with SP. The key challenge of successful SPs is the development of their services and their "brand" by creating the "Social Glue", through numerous, non-hierarchical networks of overlapping and fluid connections, and networking among individuals, firms and institutions, on the local, regional, national and international level, for economic value.

Adegboyega, Ojo, T. Janowski and E. Estevez. (2004) ever studied the core indicator for evaluating the efficiency of e-government realization measures. Bakry S (2003) ever carried out a study on development of a standard e-readiness assessment policy, where itemized standard procedures have been identified. Carbo, Toni, and Williams, J. (2004) also carried out a study on establishing models and metrics for evaluating electronic government systems and services and examined the efficiency of e-government system in terms of system application on a local region, where a sound result was identified. Chang, S. Y. (2002) proposed web service strategies for enterprises in Taiwan, where web service application on client oriented businesses was planned and experimented, with terrific results and promising prospects. Chau, Derek (2005) ever developed a generic framework for e-Government administration, where practices of e-government were experimented and verified to be efficient in administrating government services. Dutta S., Lanvin, B. and Paua, F. (2004) proposed a complete framework on global information technologies and identified possible future application and trend of information technologies, where e-government was reckoned as an inevitable route for prospective government administration. Heeks, R. (1999) carried out a study on reengineering government administration in the novel information era, where network services and business framework were expected to dominate future life style and model of prospective public services. Karim, Rais Abdul (1999) identified the leadership changes of public service model in an electronic age, where client-friendly eNet services were expected to play a crucial role in future government administration. Koh,C.E. and Prybutok, V.R. (2003) employed the three ting ring model to evaluate dimensions of e-government functions, where e-government services significantly outshined traditional government service model. Laye, K. and Lee. J. (2001) characterized the framework of a full-function e-government in terms of verification of a four stages model. Osborne, D. and Gaebler, T. (1992) discussed the innovate entrepreneurial spirits applied on public sectors, where electronic services were

identified to be a future trend. Shie, T. Y. (2003) witnessed network service application on government administration and discussed the practices in Taiwan, where e-government services were reckoned more efficient and more effective than traditional government service model. Most studies done previously reached commonly that electronic services along with innovative information technology development, especially the application of internet, will dominate future administration model of government services.

3. Background of the Hsinchu Science Park

Transformed into a world-known base for the hi-tech industry from a rural town, the Hsinchu Science Park (HSP) has gained considerable prosperity and an international reputation in the past 25 years. The HSP was established on Dec. 15, 1980, and was the first science park of its kind in Taiwan. Glimpsing the economic development decades ago, Taiwan was facing a phase when the industry transformation was a must and the government tried every way to recruit more overseas professionals to Taiwan, therefore, a first-ever science park in Taiwan was on its way. Hsinchu was then chosen because of its excellent R&D environment and great location where the transportation link was convenient.

3.1. Present Development of Hsinchu Science Park

a. Research Environment

Advantages of the HSP lie in mainly the academic and research environment. National Tsing- Hua University and National Chiao-Tung University, two leading technical and engineering academic institutions in Taiwan are adjacent to the Park. Furthermore, the Industrial Technology Research (ITRI), the largest research institute in Taiwan, is only ten minutes drive from the HSP. 6,000 researchers in ITRI engage in applied research and develop key and forward-looking technologies to meet industrial needs. All these organizations work closely with the HSP on high-tech industry research and development."

b. Living Environment

The Park area covers around 1,500 hectares and includes industrial area, residential area, recreational area, and a school. Park tenants enjoy a lot of benefits, such as land leasing, tax breaks, low-interest loan, R&D supports, grants, etc. The land can be leased for terms of up to 20 years. Water and power, internet facilities, sewerage and recycling systems are also available in the park.

c. Educational Facilities at the Park

The National Experiment High School educated children of park employees and nearby research institutes. The school offers bilingual teaching of the children of returned expatriates and foreign employees. Parents no need to worry about their kids' education at the park.

d. Park Development

Successful administrative model of the Hsinchu Science Park Administration also put forward to diffusion of cluster effect of the Hsinchu Science Park to Southern Taiwan Science Park, and Central Taiwan Science Park, where revenue of the Park broke a record high of 32 billion USD in 2004 with its almost 400 Park tenants. Regional economic elevation finds extended effect in Jhunan, Jhupei, Tongluo, Longtan, and Yilan, which gradually embarks the development of the Taiwan government set "Green Silicon Island" project.

e. Park Administration

The Park Administration is the management center in the Park, providing park companies with one-stop services, including development planning, investment services, labor

administration, commercial services, construction, land development and landscaping, information networks, public welfare and so on. Branch offices of service-related organizations are introduced into the park to make things more convenient, which includes the Customs Bureau of the Ministry of Finance, TaiPower, Chunghwa Telecom, the General Post Office, Taiwan Water Supply, China Petroleum, etc.

3.2. Current Status of Hsinchu Science Park

a. Sustainable Growth of Industry:

There are six main industries in HSP, namely integrated circuits, computers and peripherals, telecommunications, optoelectronics, precision machinery and biotechnology. The bigger industries are IC, opto-electronics and PC/peripherals. The Top-1 is IC industry, there are 169 IC companies in the Park, with almost half of tenants (see table 1).

INDUSTRY	No. of Company	No. of Employee	Sales(US$M)	Percentage (%)
IC	169	66,585	21,413	70
PC/Peripherals	56	12,790	3,174	10
Telecom	47	5,840	1,498	4.7
Opto-electronics	65	26649	4272	14
Precision Machinery	21	1506	306	1
Biotechnology	24	1,466	93	0.3
TOTAL	382	114,836	30,756	100

Table 1: HSP Current Status of Industry

b. Company by Source of Capital

Following years of effort, there are 382 companies in HSP at the end of 2005. Those 330 companies are domestic companies. 52 companies are foreign companies, 36 companies are from the U.S. 3 from Europe and 13 from Asia (see Table 2). With its mission to establish a high quality R&D base for high-tech industry development, the HSP has continuously expanded its infrastructure and facilities with total government investment to date of more than NT$100 billion (around 31 billion USD). A total of 388 hi-tech companies to date, mainly involved in semiconductor, computer, telecommunication, and optoelectronics industries. Among all Park tenants, 85% are domestic companies and 15% are foreign. Total revenue of Park companies reached 31 billion USD. The park now includes around 114,836 employees.

c. Growth of Paid-In Capitals and Growth Sale

At the end of 2005, the accumulated paid-in capital of the companies were over 35 billion US dollars. There were 164 integrated circuit companies in the Park, with total sales revenue of US$30,756 million, which represented abridgement of 5.84% from 2004. Regarding IC design, the HSP admitted 21 new IC design companies in 2005. These companies focused on designing ICs for computers and peripherals, telecommunications, and consumer electronic appliances. By the end of 2005, the Park revenue exceeded US$30,756, representing a decline of 7% comparing to the previous year, because of high oil price and supply for electronic appliances greater than demand.

d. Growth of Company within HSP

At the beginning of 1980, HSP have only 17 companies, over years the total number of companies has grown to 382. Recently, competition has been keen in the low-cost and high-function System-on-Chip (SoC) market. With the trend of digital home, and compact, high-functional, and low-cost electronic products, the domestic IC design industry has been

developing Taiwan into a global design and manufacturing center for high value-added SoCs. Furthermore, to enhance competitiveness and provide a total solution design service, the HSP Administration integrates both upstream and downstream resources and has established a center for SoC design in the Hsinchu Park; the SoC center also provides a total solution design service that capitalizes upon its advantages of being a global wafer OEM center and the availability of design services in the SoC center, combined with the introduction of intellectual property services, testing and inspection, training, and the R&D Incubator, to constantly enhance the competitiveness of the local IC industry

e. Growth of Employment and Human Resource Education level

As of the end of 2005, the Park employed 114,836 works equally split between males and females, with average age of 32 years. Two-thirds of employees possessed at least junior college.Nearly 20% of employees are with master degree or doctor degree, signifying the human resources at the Park are highly educated. In terms of human resources, the Park had 114,836 employees by the end of 2005, with two-thirds of this total having completed a tertiary education. The average age of Park employees is 30 years old, and the male/female ratio is approximately 51/49. The Park employees include over 4,646 Taiwanese scholars returned from overseas. These returnees not only contributed to the Park directly by establishing 116 companies in the Park, but also have been critical players in the evolution of the Park during the past 25 years, by introducing leading-edge technologies and management skills that have improved the high-tech and sustainable development of the Park. With the mission of sustaining current high-tech industrial development, the Park Administrationhas continued to promote on-the-job training for Park talent during the past years, by requesting National Tsing Hua University, National Chiao Tung University, and ITRI to offer on-the-job training courses dealing with optoelectronic technology, semiconductor technology, telecommunication and computer integrated applications, biomedical and biotechnological sciences, software technology, environmental engineering and management, nano-technology and applications, chemical safety and health, core advantages, project management and other management courses and seminars. During 2005 the enrollment for these courses totaled 9,591 students/time

f. R&D Related Data

HSP companies spent US$1,975 million on R&D in 2005, representing 5.8% of total annualsales revenues. In terms of total R&D expenditure, the IC industry invested most heavily with a total of US$1,485 million. Additionally, Park companies employed 12,492 R&D-related professionals; with IC firms employing 7,834 of these researchers (see table 2).

Industry	R&D Expenditures (US$M)	% of Sales	R&D Personnel	Approved Patents
IC	1,485	6.4	7,834	2,426
PC/Peripherals	184	4.3	1,887	441
Telecom	81	4.3	1055	41
Opto-electronics	196	4.8	1,378	170
Precision Machinery	16	5.6	164	16
Biotechnology	13	16.2	174	7
TOTAL	1,975	5.8	12,492	3,101

Table2: R&D related data by the Industry, 2005

g. Trading Partners of HSP

HSP had total export for US$15,356 Million in 2005. The five key exporting partners of the HSP include: China, Hong Kong, USA, Japan, and South Korea. China and Hong Kong account for 43% of the Park export. HSP had total ixport US$ 10,436 Million in 2005.. Top-4 import countries are Japan, USA, Singapore, Hong Kong and South Korea, where Japan and USA account for 55% of the Park import.

3.3. Extension Plans

a. Core and Satellite Parks

As a significantly working model, Hsinchu, the Core of HSP, has been actively working on expansion with Satellite Parks at Jhunan, Tunglou, ,Jhupei, Longtan and Yilan.
Among significant achievements achieved in recent years, HSP had spin-off two core parks: the Southern Taiwan Science Park and Central Taiwan Science Park marks the most fast-growing one of its kind in Taiwan. Totally Core and Satellite Parks, there are 11 Science Parks has been developed in Taiwan.

b. Upgrade Services

The HSP emphasizes thorough and client-oriented services. A lot of efforts have been made to meet this goal.

b.1. One-Stop Services Center– To provide better services to the Park companies, the Science Park
Administration set up the One-Stop Services Center in the Administration building; representatives from all the divisions of the Park Administration take turns to deal with tenants' application and requests.

b.2. Traffic Improvement – The most urgent problem in traffic is the lack of parking space and the traffic jams that occur during peak hours. The construction of the interchange to link adjacent city routes will help in this regard. Start running of the free shuttle bus links the Park and Park neighboring areas with great convenience. Public bus running services, e.g. Yalan Bus and United Highway Bus, link the HSP with Taipei and Taichung.

b.3. More R&D Grants – The HSP tried every way to obtain more financial support for innovative projects from the government, in an eye to elevate R&D and innovation competence of Park tenants. The government has agreed to increase the subsidy of R&D projects.

b.4. Professional Recruiting – High-tech elite plays a crucial role in pursuing sustainable progress in domestic high-tech industry development. As Park companies seeking for more overseas professionals, the Park Administration strives eagerly to help them fulfill their requests and demands.

3.4. .Key Factors Rendering the Hsinchu Science Park Outstanding Worldwide

The key factors rendering the Hsinchu Science Park globally renowned are based around the following 8 points, namely:

a. Foresight and Policy Support from the Government

Without the foresight of earlier government leaders and park pioneers, the Hsinchu Science Park would not have been so outstanding nowadays. Government policy support and venture benefits provide superior niches for foreign investors.

b. Convenient Geographical Access

Transportation is a crucial factor rendering a successful science park. The Hsinchu Science Park enjoys this important superiority. It takes only one hour drive from the Capital City-

Taipei. Necessary facilities, such as airports, harbors, academic organizations, hospitals, malls, integrated supporting industries, etc., are in adjacent areas. It is not easy to find a science park like this in the world.

c. Sound Industry Cluster Effects and Favorable Growth Environment for IT Industries

For decades of nurturing, the industrial cluster effect around the Hsinchu Science Park has fostered to a solid foundation for high-tech industry development. Necessary supporting industries, such as upstream material suppliers and downstream system assemblers have all been integrated along with the prosperous development span of IT industry in Taiwan. Favorable venture benefits and regulations come from the government put an extra add to the growth environment for IT industries.

d. Collaboration among Park Industries, Academic Sectors, and Research Institutes

The Park is located close to both National Tsing Hua University and National Chiao Tung University. These two universities include more than 18,000 students and 1,000 professors. Both facilities provide the Park's companies with excellent human resources as well as strong supports for on-job professional training. The Industrial Technology Research Institute (ITRI) is a government-sponsored non-profit organization for applied researches, which contains seven laboratories and four research centers, focusing on research and application in chemistry, electronics, mechanics, materials, energy and resources, computer and communications, optoelectronics, industrial safety and health, measurement standards, aviation and space, and biomedical engineering. Since its establishment decades ago, ITRI has developed numerous technologies, creating more than 40 spin-off companies at the Hsinchu Science Park. The Park to date also contains a number of national laboratories, e.g. the National Center for High-performance Computing, the Synchrotron Radiation Research Center, the National Space Program Office, the Instrument Technology Research Institute, the Chip Implementation Center, and the National Nano Device Laboratories in National Chiao Tung University. These research organizations cooperate closely with the Park's companies in research and development.

e .Abundant High Quality of Human Resources and Venture Capital

Without high-quality of human resources and abundant venture capital, the development of a science park will be confined. 67% of park employees own college-above degrees. The average age of the employees is 31. Brainpower is the best estate that elevates the competitiveness and growth potential of park industries. Abundant capital ventured from domestic sectors as well as foreign resources further fertilized the high-tech sprouts at the park.

f. Venture and Technology Brought by Returned Overseas Chinese Elite

Returned overseas Chinese elite played an important role in the process of park development.

Owing to the technologies and business concepts they brought back from the US in 1970s and 1980s, high-tech industries have effectively cultivated and blossomed in Taiwan. There are so far more than 4,000 returned overseas Chinese working at the Park. Amazingly, more than 110 out of the total Park tenants are founded by overseas Chinese.

g. Smooth Transformation of Domestic Conventional Industries

Prosperous development experience of the Hsinchu Science Park has inspired a large scale of industrial transformation and technology innovation in Taiwan along with the development span of the Hsinchu Science Park. Conventional industries have successfully transformed in technical level as well as management style.

h. One-stop Administrative Services

The one-stop administrative services provided by the Science Park Administration provide the Park tenants with fast and efficient administrative services. Tenants can put their full effort on managing business without paying much attention on time-consuming administrative affairs. It becomes more convenient for Park tenants in handling related applications especially after the launch of on-line services of the eNet Service System. The success of the Hsinchu Science Park is not a luck but the endeavor come from the government as well as private sectors. Right direction guided by the government and endeavor dedicated by diligent pioneers and industry leaders are most important and crucial.

4. The eNET services-Innovative Knowledge Networks as a competitive powerhouse

For acheving the objective of fostering a virtual science park , the Park Administration provides a wide variety of services, as mentioned in Srategic Plan of Hsinchu Science Park for 2004-2008 by HSPA.（See Figure 1）With a strategic thinking of vision, the progress of network service technology and telecommunications innovation, novel model of Park Administration is a must, in an eye to provide Park tenants efficient and superior quality of services. As a preliminary work plan of the virtual science park, the Park Administration has deployed the e-administrative service network, which integrates Park tenants oriented database management system and Park management information system to provide Park tenants systematic and transparent electronic services, under a concern of knowledge diffusion and information sharing.

Pre-requests of fostering the Park as a virtual science park under concerns of offering Park tenants efficient administrative services lie in transforming traditional service model into a novel ones, where existent service items have to be covered and incorporated in the e-administrative system. Tenants do not need to reach on spot to deal with business operation related affairs, e.g. investment application, corporation registration, start-work application, environment protection related applications, construction related applications, land development related affairs, etc.

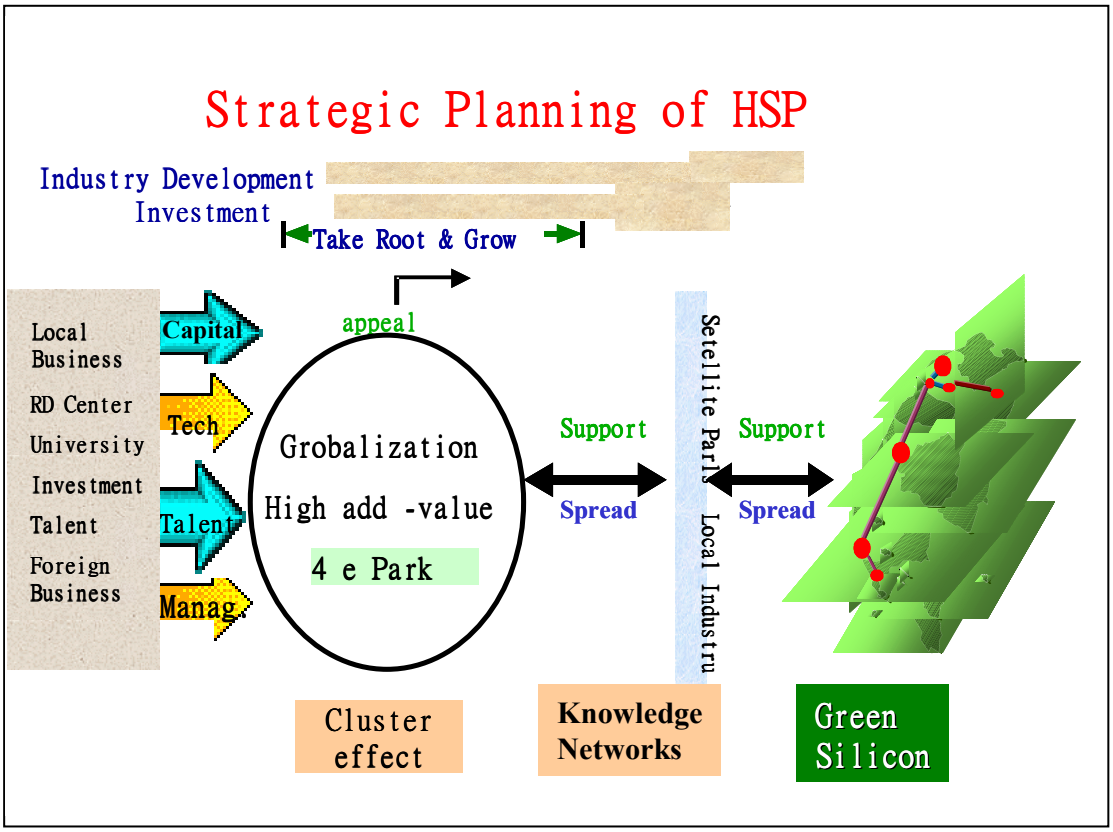

Figure 1: Srategic Plan of HSP for 2004-2008

4.1. System Operation Scope

The established eNet service system provides a wide variety of services, covering investment application, corporation setup, corporation operation, fee collection, company registration, operation business data modification, etc., based on a superior tenant-oriented database management system. Tenants can pay related fees in the system in terms of data exchanging with banks via employment of electronic certificate, i.e. electronic signature. Traditional paper form application was no longer required in this novel system.

4.2. Design Framework of the eNet System

The system is designed in a manner of custom-oriented service model and knowledge-based sharing mechanism, where related services, e.g. investment application, business registration and amendment, labor and environment protection related applications, construction management related application, fab and dormitory leasing, water and power use application, land use application, etc., are separated into client's portion and manager's portion and linked with XML data exchange mode, where a bank charging system is incorporated in the established system to provide related payment services. The overall system design chart looks like:（See Figure 2）

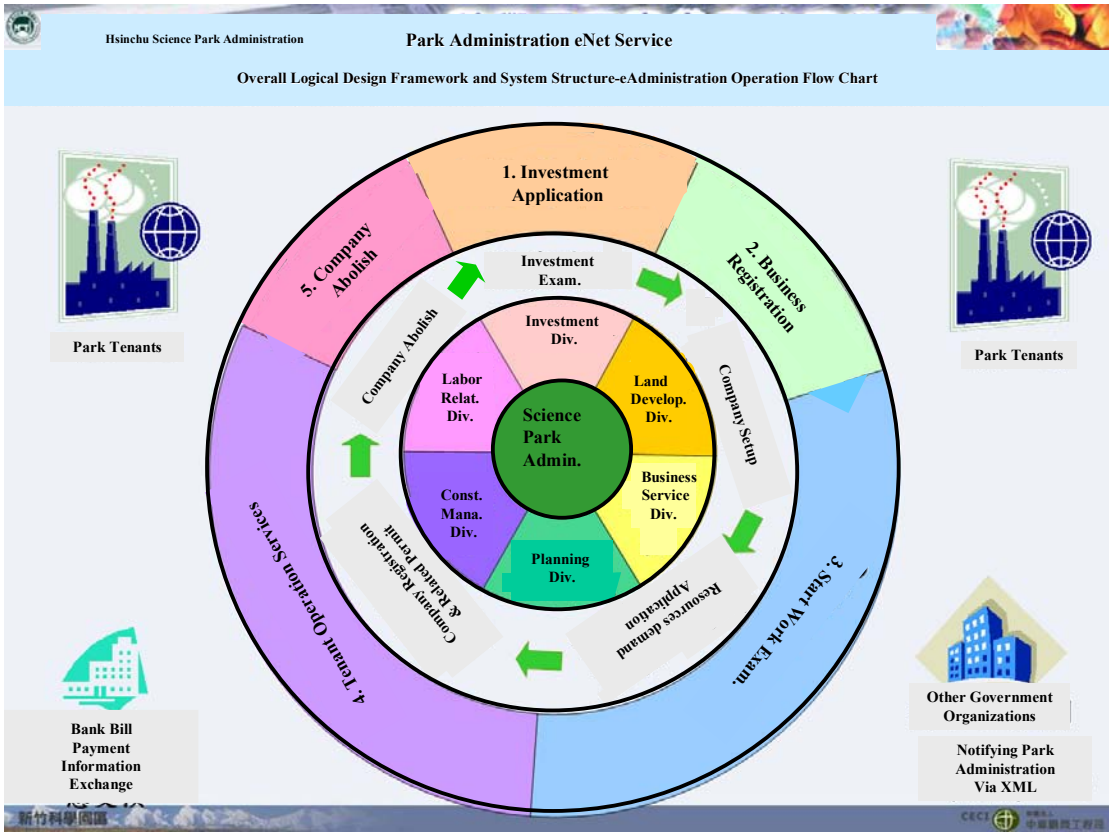

Figure 2: eNet Services Working Chart

4.3. System Operation Framework

The system operation framework of the eNet service system is of two parts, namely the external data operation system, i.e. tenants' side, and the internal data operation system, i.e. the Park Administration side, and related government organizations, e.g. National Business Data Operation and Management

Center, Ministry of Economic Affairs, Custom Bureau, etc. An Oracle database system incorporating with XML data exchange services, document database management system, data sharing database, national business database interface, mail server, identification verification system, work flow operation system, paying system, abnormal procedure management system, filing system, etc. have be established in the system. Tenants can just click the mouse and complete all related services in an efficient manner. The system framework looks like:（See Figure 3）

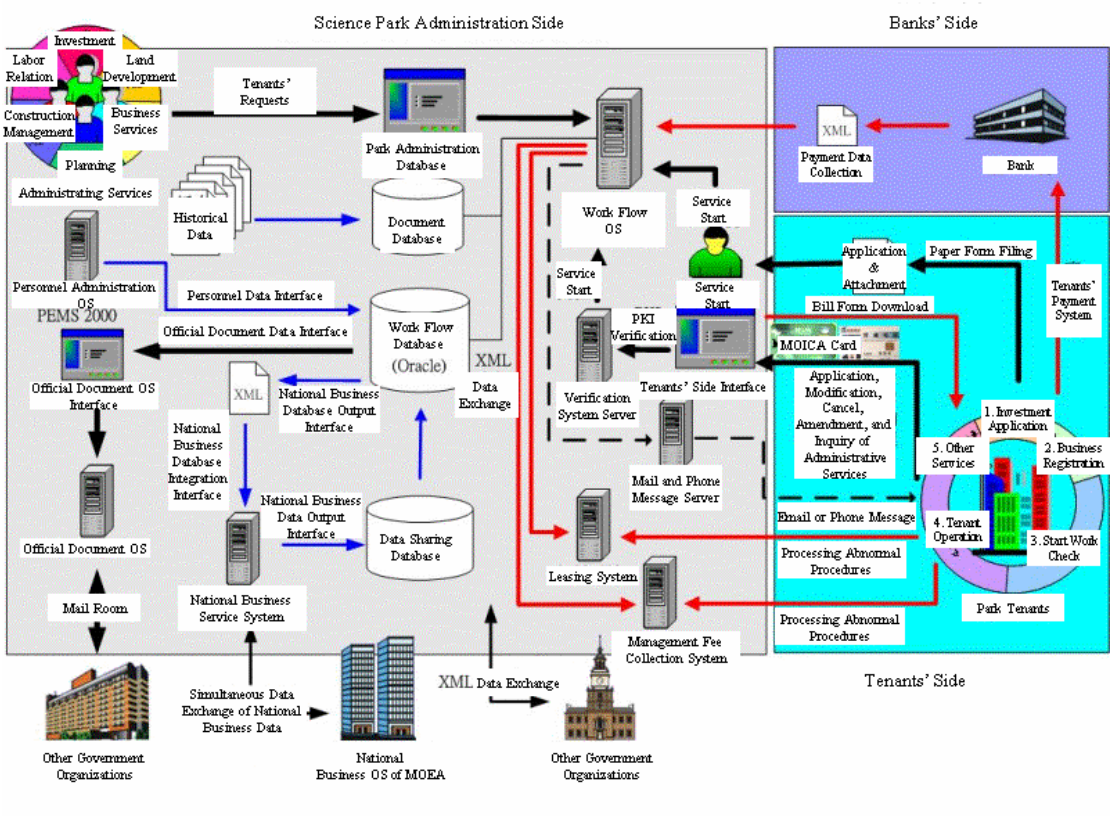

Figure 3:System Framework of the Science Park eNet Services

4.4. System Working Flow

To provide Park tenant fast and superior quality of services, the eNet service system works in a smart way, where four operation portions are closely linked, namely the e-application management system, the filing management system, the file consulting system, and the report management system. Besides, the eNet service system works in the same manner of friendly one-stop service model, where on-line application, supporting inquiries, Q&As, operation guides, etc., are incorporated in the system. Tenants are required to get the identification certificate beforehand to fulfill related administrative services. As soon as required services are completed, notices will be released to the tenants in terms of email or phone message. An e-payment system is also incorporated in the system to carry out related payment affairs. Tenants can consult payment results via the report management system through XML data exchanges.

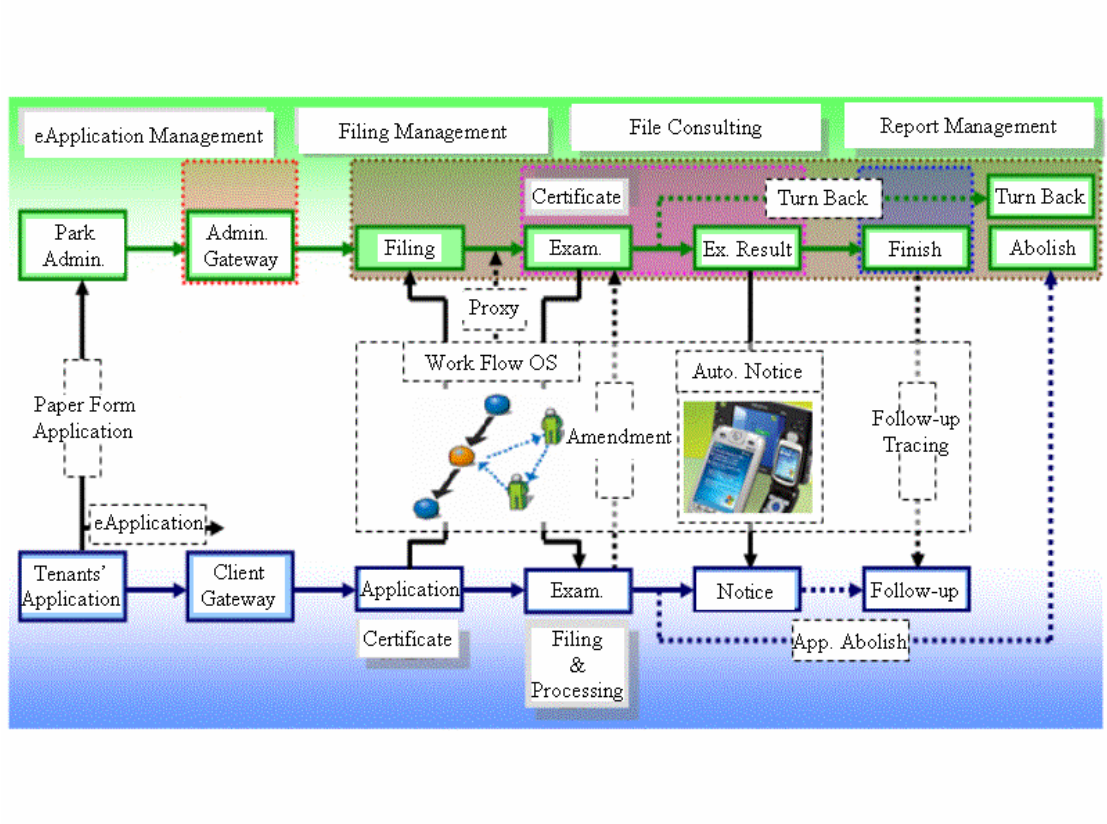

Figure 4:eNet Service Working Flow Chart

5. Results

The eNet Service System established has found its wide application on a variety of park administration affairs after on-line practices for months. Either clients, the Park tenants, or the administrator, the Science Park Administration, are satisfied with the system performance.

The efficient and effective operation model of the established eNet Service System not only saves a lot of time originally spent on waiting list but also render a convenient operation environment for clients in dealing with related applications. 85% of time spent on trivial affairs, paper form document preparation, waiting list, etc. can be effectively shortened via the established smart system.

Three Ls, i.e. less complain, less worry, and less trouble, and three Ms, i.e. more satisfaction, more trust, and more efficiency, are commonly reckoned performances of the practiced results, where clients, i.e. the Park tenants, can enjoy the fast and efficient services provided by the administrator, which share similar service content with the manual ones but more efficient and effective.

A questionnaire done on surveying clients' feedback regarding the eNet Service System revealed that Park tenants are very satisfied with the novel system in handling related application affairs, comparing to the traditional approach. Most Park tenants expect extended services in the future to more application items and more administration related affairs. As for the Park Administration, much labor can be saved in terms of the novel system and worry of manpower layoff was effectively resolved via job shifting and new business exploration, where service quality is effectively elevated and time spent on trivial cashing and payment affairs of related fee collection, accounting, and financial checks is effectively saved.

Though the established system is initially applied on limited service items of the existent content, the system can be soon expanded to cover more jobs and services items to satisfy clients demands. Besides, the established eNet Service System can also find wide applications on administrating affairs of domestic science parks, e.g. Central Taiwan Science Park and Southern Taiwan Science Park,

where a virtual science park administration can be realized in terms of the system, which meets the initial goal of the novel project. (see Figure 5)

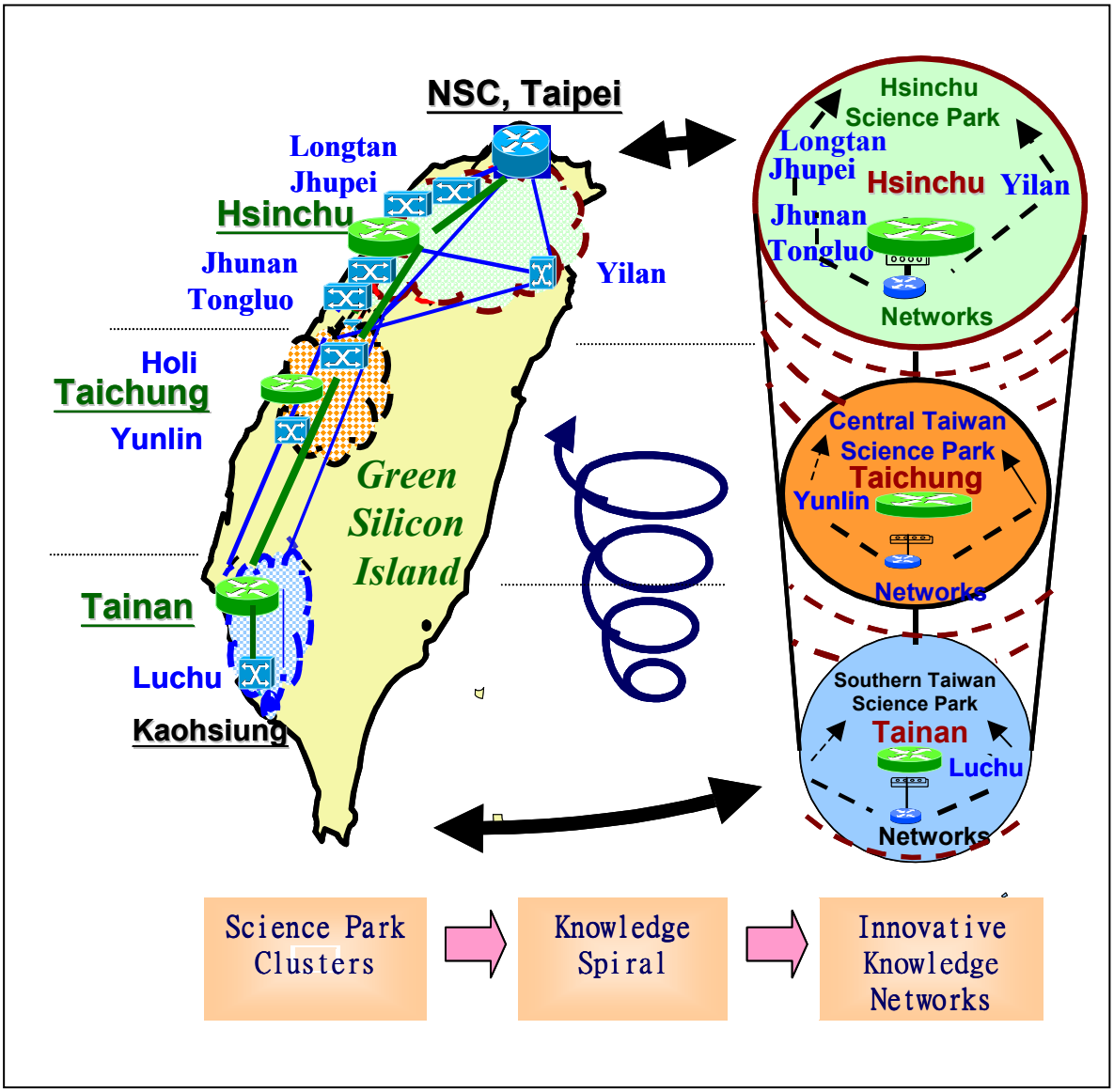

Figure 5:The Future of Science Park Clusters in Taiwan: Innovative Knowledge Networks

6. Conclusion

Pursuing efficiency, cost-saving, and performance is reckoned as the first priority for offering knowledge-based high-tech industries the world-class services. With dramatic changes of modern high-tech industries and revolution of Internet and telecommunication related technologies; government services are subject to make proper adjustment to meet demands from high-tech enterprises. This realization is especially true for administration organizations in offering public services. High-tech enterprises do not have time to wait for government's services but look for prompt response and services in right time.

The Hsinchu Science Park shoulder national high-tech industry development missions coincided with government's policy of promoting Taiwan as a Green Silicon Island, pursuing a sustainable and client-oriented investment environment right for flagship enterprises all over the world. Traditional service

model is no longer feasible, even the Park is renowned with its brilliant past. Grasping the latest technologies and transforming them into realities are a must for the Park Administration in elevating not only its own competence but also the overall competitiveness of Park tenants. Only efficient and effective administrative services can guarantee an absolute superiority for high-tech industries. Ecological, economic and electronic are three traits that ideally characterize the science parks in Taiwan. The Hsinchu Science Park is expected to serve as the engine and powerhouse for domestic high-tech industry development and local economic prosperity. With novel service ideas and administration approaches, the Park can definitely help Taiwan realize its vision of becoming a Green Silicon Island in the coming future.

The Hsinchu Science Park has not only fulfilled the government-set national science and technology development objectives, i.e. fostering domestic high-tech industry development and innovation of next generation technologies, but also extended its development scope in parks networking to the satellite parks- Jhupei, Longtan, Jhunan, Tongluo, and Yilan after endeavor of quarter of a century. The Central Taiwan Science Park and Southern Taiwan Science Park will follow the paces of the Hsinchu Science Park and optimize utilization of related resources and competence to solidify Taiwan as the first class of global high-tech R&D and manufacturing center via attracting outstanding high-tech talent and piloting enterprises worldwide.

To cope with trend of globalization, the Park also seeks foreign collaborative partnership to extend linkage with global community, in an eye to diffuse the successful experience of the Hsinchu Science Park. Science parks in Taiwan are expected to track the route of the Hsinchu Park and fulfill government-set goals to create another economic miracle in Taiwan in coming next 25 years.

References

1. Stewart Brown, Gary Ho and Katherin Peters, 2005, Science and technology parks and their connections within innovation networks: a holistic approach to analysis of policy and practice in China and Europe, Conference proceedings of XXII IASP World Conference on Science and Technology Parks, Beijin, China
2. Ari Virtanen, Zhan, K. and Janhunen, H, 2005, International network of science park is valuable for high-tech SEMs, Conference proceedings of XXII IASP World Conference on Science and Technology Parks, Beijin, China
3. European Commission, 2004, Innovation management and the knowledge-driven economy. Report of the Directorate-general for Enterprise.
4. James Lee, 2005, Science Park & international cooperation, Proceedings of Global High-tech Industry Forum of the 25th Anniversary of Hsinchu Science Park, Taiwan.
5. Luis Sanz, 2005, Strategigram: a tool to understand and compare the strategy of STPs, Proceedings of Global High-tech Industry Forum of the 25th Anniversary of Hsinchu Science Park, Taiwan.
6. Andre Vander Beken , SOC/RATE project of the European Thematic Network of Education and Training (ETNET21), 2002-2003
7. Accenture (2002) "e-Government Leadership - Realizing the Vision", [online], http://www.accenture.com/xdoc/en/industries/government/egov_april2002_3.pdf.
8. Adegboyega, Ojo, T. Janowski and E. Estevez. (2004) Determining Progress Towards e-government: What are the core indicator. Proceeding from ECEG2005, Amsterdam.
9. Bakry S (2003) "Toward the development of a standard e-readiness assessment policy", International Journal of Network Management, Vol. 13, pp129-137.
10. Basu, S. (2004) E-government development An overview." International Review of Law, Computers and Technology 18(1). 109-132.

11. Carbo, Toni, and Williams, J. (2004) "Models and Metrics for Evaluating Local Electronic Government Systems and Services", Electronic Journal of e-Government, Vol. 2, Issue 2, pp95-104.
12. Chang, S. Y. (2002) Web Service Strategies for Enterprises. Information and Computer Journal, 15-21 December 2002.
13. Chau, Derek (2005) Developing a Generic Framework for E-Government. Journal of Global Information Management, 13(1), 1-30, Jan-March2005 http://www.igi-online.com/downloads/pdf/ITJ2725_dGLKgMR9SK.pdf.
14. Deloitte Research, Public Sector Institute. At the dawn of e-government. The citizens as customer.
15. Dutta S., Lanvin, B. and Paua, F. (2004) "The Global Information Technology Report," Oxford University Press.
16. Heeks, R. (1999) Reinventing government in the information age. London and New York Routledge. P 9-12.
17. Karim, Rais Abdul (1999) Reengineering the public service: Leadership and change in an electronic age. Subang Jaya Malaysia Pelanduk Publ.
18. Koh,C.E. and Prybutok, V.R. (2003) The three ting ring model and development of an instrument for measuring dimensions of e-government functions. Journal of Computer Information Systems 43 (3) 34-39.
19. Laye, K. and Lee. J. (2001) Developing fully functional e-government: A four stage model. Government Information Quarterly, 18 122-136.
20. Osborne, D. and Gaebler, T. (1992) Reinventing government: How to entrepreneurial spirits is transforming the public sector. New York: Plume.
21. Shie, T. Y. (2003) Network Service Application on Government Administration. Research and Development Bimonthly, 27 (1) 50-62.
22. Hsinchu Science Park Administration, Taiwan, （ 2004 ）"Strategic Plan of Hsinchu Science Park Report for 2004-2008".
23. Hsinchu Science Park Administration,Taiwan, （ 2005 ）"Hsinchu Science Park eNET services Report".
24. Hsinchu Science Park Administration,Taiwan, （ 2006 ）"Annual Report 2005".
25. Website of Hsinchu Science Park Administration, Taiwan: http://www.sipa.gov.tw