



Pergamon

Technovation 20 (2000) 55–59

technovation

www.elsevier.com/locate/technovation

Industrial Viewpoint

The cradle of Taiwan high technology industry development — Hsinchu Science Park (HSP)

Wen-Hsiung Lee ^{a,*}, Wei-Tzen Yang ^b

^a Hsinchu Science Park Administration, 2, Hsin Ann Road, Hsinchu, Taiwan, ROC

^b Institute of Management Sciences, Tamkang University, Tamsui, Taiwan, ROC

Received 19 March 1998; received in revised form 3 February 1999; accepted 7 April 1999

Abstract

As the first hi-tech industry development benchmarking model in Taiwan, it has been appreciated that governmental support and human resources are the most essential factors in HSP's performance, and the electronics information related industries (EI) have contributed mutually through improved management strengths. © 1999 Elsevier Science Ltd. All rights reserved.

Keywords: Electronics information industry; Co-optive strategic alliance; Internationalization; Global hi-tech human resources network

1. Introduction

In order to attract hi-tech entrepreneurs and facilitate their taking root in Taiwan, the Hsinchu Science Park (HSP) was established in December 1980. It is fully government oriented, for example, by the development of public land with infrastructure facilities; efficiently supported one stop service; domestic and international network; automated customs service and on-job training etc. Through its continued efforts, the following industries have been successfully developed: Integrated Circuits (IC), Computers and Peripherals (C&P), Telecommunications (Telecom), Opto-electronics (Opt E), Precision Machinery (PM), and Biotechnology (Biotech). Its performance also demonstrates its honor in becoming the first hi-tech industry development benchmarking model in Taiwan and also its outstandingly favorable reputation in the world.

During the last 18 years, the government has invested more than US\$583 million in software and hardware facilities for the park. By the end of 1998, the HSP had 272 companies with combined annual sales of more than US\$13 billion and aggregate investments of US\$15 billion. There were 72,623 people working there of

which 58% had at least a junior or technical college education. The average age of the workers was 31 years and returned overseas Chinese hi-tech experts played an important role in the development of the park. One-hundred and nine companies were founded by 3057 “reverse brain-drain” people working in HSP, their hi-tech relevant skills, experience and innovative ideas being valuable seed corn from which to stimulate and promote the close linkage between HSP and the Silicon Valley, which naturally formed a global healthy strategic alliances co-option network.

1.1. Academic support

In the vicinity of the HSP, there are research and educational institutes, such as the National Chiao Tung University, the National Tsing Hua University and the Industrial Technology Research Institute (ITRI). Three national laboratories are the National Center for High-performance Computing, the Synchronous Radiation Research Center, and the National Space Program Office. Other supplementary research centers include the Precision Instrument Development Center, the Chip Implementation Center and the National Nano Device Laboratories, and there are also educational institutes and training centers which furnish the product research and talents enforcement activities.

* Corresponding author. Tel.: +886-3-5773311 ext. 215; fax: 886-3-5788030.

E-mail address: cecilia@sipa.gov.tw (W.-H. Lee)

Nomenclature

ABRAIGaInP	Aluminum–Gallium–Indium–Epi Phosphorous Epitaxial
Biotech	Biotechnology
CAGR	Compound Average Growth Rate
C&P	Computers and Peripherals
DRAM	Dynamic Random Access Memory
DVD	Digital Video Disc
EI	Electronics Information
HDSL	High-Rate Digital Subscriber Loop
HSP	Hsinchu Science Park
IC	Integrated Circuits
IP	Intellectual Property
ISDN	Integrated Service Digital Network
ITRI	Industrial Technology Research Institute
LED	Light Emitting Diode
Opt E	Opto-Electronics
PM	Precision Machinery
R&D	Research and Development
Telecom	Telecommunications
TFT–LCD	Thin Film Transistor–Liquid Crystal Diode
TSP	Tainan Science Park

1.2. Environment

The HSP covers about 600 ha, divided into industrial, residential and recreational areas. Because of limited space for future development near to the park, the 4th phase extension project is being undertaken and additionally about 467 ha will be developed in the near future. The Tainan Science Park (TSP) in southern Taiwan was established in July 1998 and by the end of 1998, 28 companies had started their factory construction. The back-up and co-operation between the two parks should markedly promote the balance of regional hi-tech industry development in Taiwan.

The quality of life is the important cultural content of the HSP community. In pursuit of environmental protection and cultural enrichment, HSP also plays a model building role in Taiwan (Figs. 1 and 2).

1.3. Internationalization

More than 40 companies have complied with ISO9000, 47 companies have established offices abroad and many well-known foreign manufacturers are closely linked in related co-operations. Cross licensing, strategic alliance, and even joint investments in Singapore, Japan and the United States also push HSP into the global hi-tech industry community as one of its indispensable key members.

To keep pace with the most advanced science and technology development in the world, HSP also actively

joins in the global standards establishment business in IC, telecommunications, networking and new, innovative product research and development.

1.4. General performance

Table 1 shows the general performance of HSP development. Compared with the Taiwanese manufacturing industry, the average HSP R&D investment was 5.0% rather than about 2%; the labor productivity of HSP was US\$169.3 k/man-year rather than 86.5 – almost doubled. It is shown that by industry (Table 2 shows the 1998 performance), the EI related industries were mutually effective and dominated more than 98% of HSP's contribution. The R&D investment related to labor productivity implies somewhat that the innovative effectiveness of R&D does not operate properly in HSP industries.

Confronted with the 1998 crucial challenges of economic recession and financial crises in the world, HSP encouragingly had a growth in investment: 42 new companies (HSP-32, TSP-10) with US\$968 million, and 84 existing companies raised more than US\$4 billion investment, as shown in Tables 3 and 4.

1.5. Industry performance 1998

The IC industry has undergone concentrated vertical disintegration so that the specialized foundry, design, masking, packaging and testing operations were working closely, as was the horizontal strategic alliance, both domestically and abroad. The foundry, design and DRAM products dominate its main business. The C&P industry laid emphasis on new, innovative niche products, such as notebook computers, internet cards etc. The rechargeable lithium battery, TFT–LCD, LED, AlGaInP Epi wafer, DVD read head, digital cameras were new niche products in the Opt E industry. Telecom industry centered primarily on ISDN terminal equipment, cordless telecommunication and sound/vision technology. The new opportunity for PM industry will be in the semiconductor equipment area, upstream back up to the semiconductor industry. The reengineering transition effort is the HSP innovative oriented future challenges.

2. The impact and contribution of HSP

The main impact and contribution achieved by HSP are that it:

- Successfully established the first science park model in Taiwan and effectively introduced the relevant hi-tech human resources for technology and economic development: promoted Taiwan to the 3rd position for

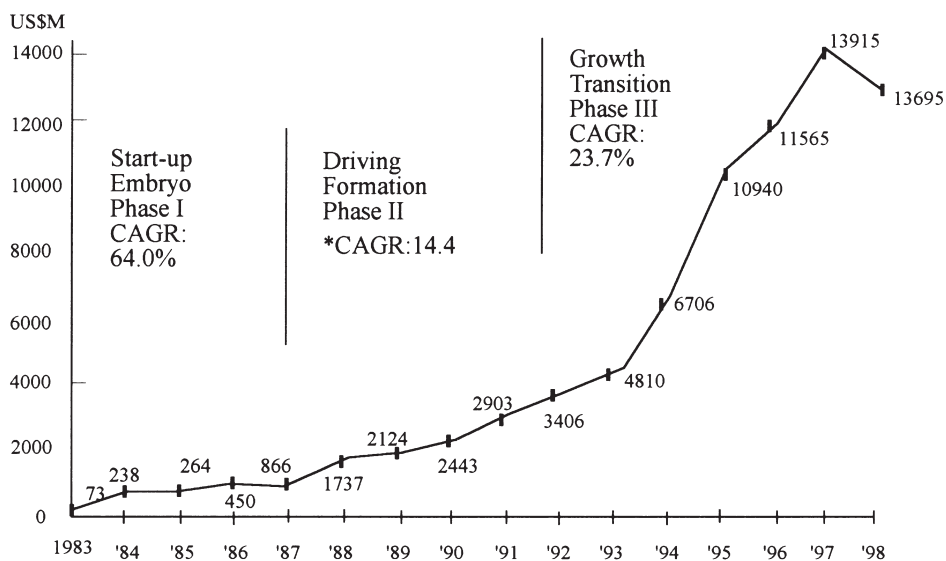


Fig. 1. Phased HSP growth of sales. *Compound Average Growth Rate $CAGR = \sqrt[n]{Y_n/Y_1} - 1\%$, where Y_n is last year's value, Y_1 is the first year's value and n is the no. of years in the phased period.

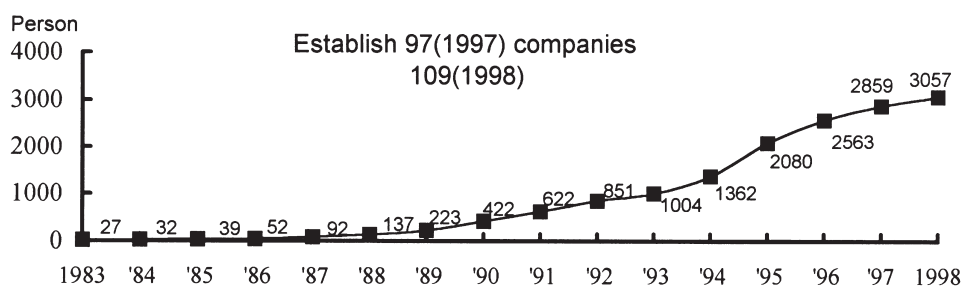


Fig. 2. Overseas Chinese hi-tech experts who returned to HSP.

Table 1
General performance of HSP

Year	No. of companies	Paid-in capital US\$M	No. of employees	Sales, growth US\$M, %	R&D/sales %	Labor productivity US\$ k/man-year
1998	272	15,316	72,623	13,693/−15.96 ^a	—	188.6
1997	245	13,080	68,410	13,915/20.32	6.2	203.4
1996	203	9391	54,806	11,565/5.71	5.6	211.2
1995	180	5400	42,257	10,940/63.14	4.2	258.9
1994	165	3527	33,538	6706/39.42	4.8	199.9
1993	150	2495	28,416	4810/41.22	5.0 ^b	169.3 ^b
1992	140	2460	25,148	3406/17.33	5.4	135.5
1991	137	2059	23,297	2903/18.83	6.0	124.4
1990	121	1590	22,356	2443/15.02	5.4	109.1
1989	105	1072	19,071	2124/22.28	4.6	111.3
1988	94	561	16,445	1737/100.58	5.1	105.6
1987	77	332	12,201	866/92.44	4.7	71.0
1986	59	151	8275	450/70.45	—	54.4
1985	50	102	6670	264	—	39.6
1984	44	81	6454	—	—	—
1983	37	48	—	—	—	—

^a On the NT\$ basis, 1998 sales growth: 13.87%; US\$ (−15.96%); NT\$ was depreciated.

^b 1993 Taiwanese manufacturing industry: R&D/Sales: about 2%; labor productivity: US\$86.5 k/man-year.

Table 2
HSP industry performance, 1998^a

Industry	No. of companies, %	Paid-in capital	No. of employees, %	Sales, G.R.	Labor productivity US\$ k/man-year	R&D/sales (1997) %
		US\$M, %		US\$M, %		
IC	112/41.2	11,705/76.2	41,253/56.8	6946/−0.20	168.4	8.0
C&P	47/17.3	1819/11.8	16,623/22.9	4812/−1.96	289.5	3.4
Opt E	39/14.3	1105/7.2	7657/10.5	896/−7.60	117.0	8.5
Telecom	44/16.2	562/3.7	5170/7.2	796/−15.74	154.0	5.1
PM	15/5.5	111/0.7	1554/2.1	226/90.08	145.4	5.0
Biotech	15/5.5	65/0.4	366/0.5	17/20.57	46.5	30.3
HSP	272/100.0	15,367/100.0	72,623/100.0	13,693/−15.96	188.6	6.2

^a The EI related industries: IC, C&P, Opt E and Telecom were equally effective and dominated more than 98% of HSP's contribution.

Table 3
New company capital investment, 1998

Industry	No. of companies	Investment US\$M
IC	18	488.0
C&P	7	63.4
Opt E	8	325.8
Telecom	7	75.7
PM	0	0
Biotech	2	15.0
Total	42 ^a	967.9

^a HSP:32, TSP:10.

Table 4
Existing company capital raised, 1998

Industry	No. of companies	Capital raised US\$M
IC	39	2781.4
C&P	15	395.2
Opt E	13	730.9
Telecom	11	100.0
PM	3	26.7
Biotech	3	8.1
Total	84	4042.3

EI and 4th position for IC in the world. The EI, also well clustered in Taiwan, has been fully recognized as fulfilling an indispensable role in the world.

- Stimulated R&D innovative investment, through the cross licensing and strategic alliance co-optive oper-

ations, the synergetic effect of which accumulated the potential momentum for global activities.

- Upgraded the national core competence, tightly linked the global hi-tech human resources network and strengthened the reengineering consensus for the future “Silicon Island” project implementation.
- Cultivated the hi-tech quality of life culture for social progress improvement.
- Provided a worthy real reference model for the next regional hi-tech industry development plan.
- Demonstrated permanent dynamic flexibility, best fit adaptation, enduring fast follower and young, aggressive, outstanding character in entrepreneurs, which has been well recognized globally.
- As EI is the top leading industry (since 1993) and HSP dominated more than 20% of its contribution, it is widely recognized that the HSP is the driving force of hi-tech industry development in Taiwan.

The emphasized focuses upon R&D, intellectual property (IP), strategically niched product development, “small but smart”, high value-added innovative oriented operations are the next missions which HSP will be pursuing.

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Wei-Tzen Yang, is a professor and a member of the Institute of Management Sciences in Tamkang University, Taiwan. He received a Bachelor's degree in Electrical Engineering in 1955 from National Taiwan University and a Ph.D. from Tokyo Institute of Technology in 1973. His research focuses on operations research, system dynamics, decision analysis and industry management.



Wen-Hsiung Lee, has been a senior engineer at the office of planning of the Hsinchu Science Park Administration since 1983. He received a Bachelor's degree in Electrical Engineering in 1967 from Tatung Institute of Technology, Taiwan; a MBA degree in 1988 from the Oklahoma City University, USA. In 1990 he entered the Ph.D. program in Management Sciences at Tamkang University, and most of his research to date has been in the field of hi-tech industry development issues.